ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

Vol. 9. No. 18. WEEKLY. | NEW YORK, SATURDAY, JANUARY 1, 1887. | $3 per annum. Single Copies, 6 Cents.

Copyright, 1886, by ELECTRICAL REVIEW PUBLISHING COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Plant for Storage Batteries.

In order to charge storage batteries or accumulators by the means of magneto or dynamo machines, an especial apparatus has to be placed upon the circuit so as to prevent accumulators from getting discharged into the current generating machine and thus rendering it unfit for use. *La Lumiere Electrique* publishes the following: "The purpose of the switch is to automatically connect the accumulators to the electrical machine when the latter has an electromotive force sufficiently high to produce the charge, and to sever the connection as soon as the electromotive force of the machine becomes unable to do the charging.

They have to be especially resorted to when the machines are operated in an intermittent manner, for instance, during the process of lighting railroad cars, the electrical machines being then operated through the axle of a truck. When the train speed slackens the connection between the machine and the accumulator is automatically cut off. As soon as the regular speed is resumed the circuit is again closed.

THE BERJOZ SWITCH.

The circuit which includes the battery of accumulators is closed by a wire, the two ends of which are dipping into two mercury cups g and g' (Fig. 1); this wire is rolled around a soft iron rod A, which is pivoted upon one of the pole pieces B of the machine. The end N of the rod is placed above an extension n of the pole piece, and the lever A comes in contact when at rest upon a stop piece, C.

When the machine begins to move, the accumulator's circuit is open at first, the ends g and g' do not dip in the mercury, and the current of the machine runs only through the field magnets. The result is that the pieces N and n assume the same magnetic polarity, thus causing a repelling of pole N; instantly the ends of the wire A get dipping into the mercury thereby closing the secondary battery circuit; the current which runs through the wire, in the meantime increases this effect by reinforcing the magnetic polarity at N.

Should the machine speed become slack, the current weakens, causing in turn a decrease of magnetism in the poles N and n. The pole N moves down, the wire ends leave the mercury cups and the accumulator's circuit is interrupted until the regular speed re-appears.

A. VARLET'S SWITCH.

After having put in operation a great many plants of accumulators, Mr. Varlet, of the Edison Company, has invented a system of switch which enables him to obtain all the practical combinations of accumulators with the machine and with the electric lamp's circuits.

The switch which is shown in Fig. 2 is composed of 6 blocks, one of which, A, does not connect with anything. Between the two contacts E and F there is a pin Y which is like those used in rheostats.

A handle the axle of which carries a cut out with a pin X is capable of moving successively on the five blocks A, B, C, D, E, so as to send the current from the machine to the accumulators, or the current from the accumulators to the lighting circuits.

ARRANGEMENT OF A. VARLET'S SWITCH.

The handle pivot is connected to the lighting circuits.

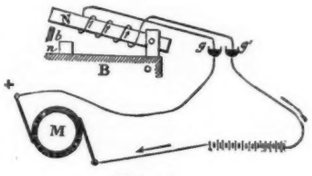


Fig. 1.

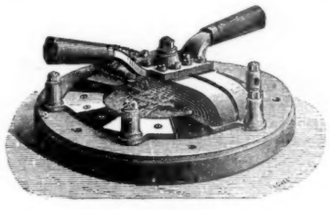


Fig. 3.

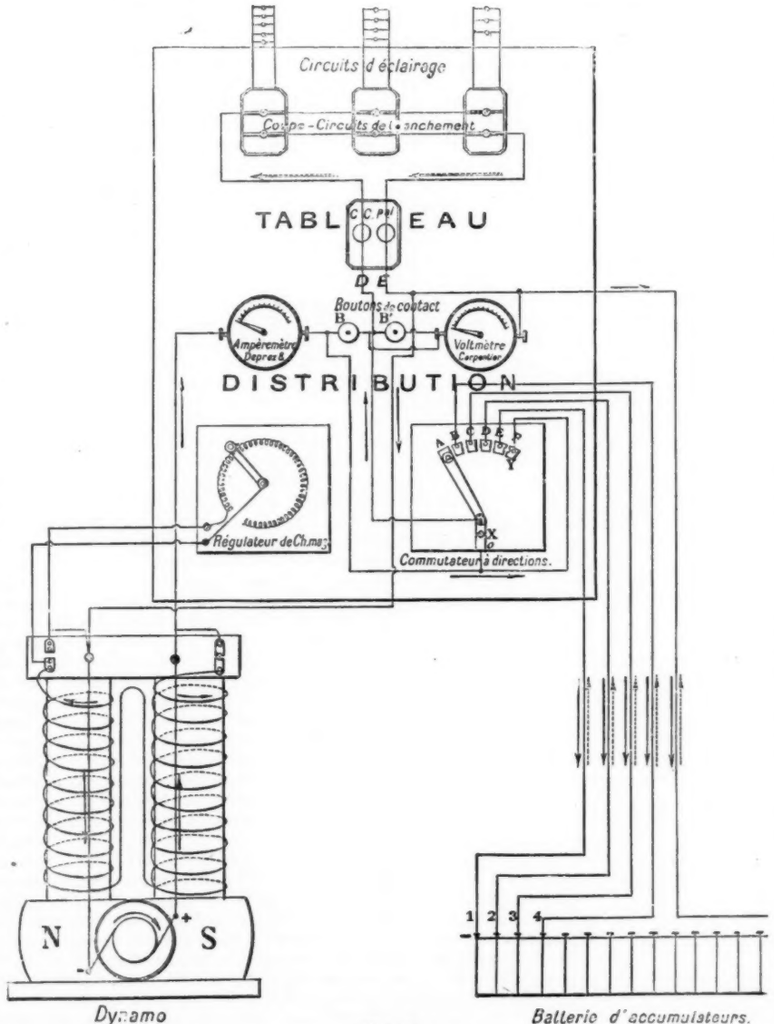


Fig. 2.

The blocks F and o are connected with the positive screw post of the machine, while the blocks $E\ D\ C\ B$ are connected with the negative screw posts of the accumulators 1, 2, 3 and 4, beginning from the negative end of the battery.

The positive screw post of the battery is connected with the negative screw post of the machine.

HOW TO OPERATE THE SWITCH—CHARGING.

To charge only a part of the accumulators, insert the pin X, take out the pin Y, and turn the handle on one of the blocks $B\ C\ D$, according as one wishes to charge 1, 2 or 3 accumulators less than the whole of them.

To charge the whole battery of accumulators, insert the pin Y, take out the pin X, and turn the handle on the unconnected block.

DISCHARGING.

The connection between the machine and accumulators is supposed cut out.

To discharge only a part of the accumulators, insert the pin X, take the pin Y and turn the handle on one of the blocks $B\ C\ D$, according as one wishes to discharge 1, 2 or 3 accumulators less than the whole of them. To discharge the whole battery of accumulators, insert the pins X and Y, and turn the handle on the unconnected block, or insert the pin Y, take out the pin X, and turn the handle on the block E. This last method is the best for prudence sake, for should they, while following the former method, forget to cut out the machine, the latter could be damaged by the discharging of the accumulators, in case an automatic cut-out would be wanting.

SIMULTANEOUS CHARGING AND DISCHARGING.

To charge the whole battery of accumulators while the lamps are being operated, insert the pin Y, take out the pin X, and turn the handle on one of the blocks $B\ C\ D$, according as one wishes to discharge 1, 2 or 3 accumulators less than the whole of them. All the switches used to increase the number of accumulators in the lighting circuit have the defect of short-circuiting the accumulators, which falls between the two successive contacts.

This short circuiting causes a loss of power, with sparking; there is a remedy, but it is by the means of a much more complicated switch.

The Woodhouse & Rawson firm has constructed a switch by which this short circuiting is prevented (Fig. 3). It is composed of two moving handles, capable of being brought in contact with the several blocks which are connected with the battery elements. The two moving handles are connected, one with the other, through resistance coils, and are so placed that one of them entirely leaves one of the contact places before it touches the next one. At the time one of the handles touches a plate, the battery element, or elements, which are situated between two successive contacts, are closed upon the intervening resistance coil, until the motion is completed, and until they be directly placed into the main circuit. This switch does not permit, like that of Varlet, to obtain all the combinations which are necessary in an electric light plant.

Glow Lamps, Their Use and Manufacture.

General Webber writes the following to the London *Electrician*:

It is not my intention to enter into any dissertation on the various kinds of glow or incandescent lamps which have appeared from time to time since their first use by De Moleyns, Starr, and King, between 1840 and 1850, nor do I wish to trouble my audience with the history of inventions which have led up to the so-called glow-lamp now in commercial use. The word "incandescent" or "incandescence" lamp is, like all other adjectives of four syllables, cumbersome, and the word "glow" has been adopted by many, and is for our purposes sufficiently expressive to identify a means of domestic illumination now almost as familiar to the public eye as the gas jet. From the point of view whence I beg my audience will regard the subject, it is my desire to lead them to realize that in the manufacture of glow lamps we have a rapidly growing industry, in the increase and efficiency of which they may all before long be interested. And I shall only remind them of the antagonisms of rival inventors and the struggles for precedence arising out of the same when that part of the question is necessary to my subject. It is true that the time has not yet arrived when a general audience can be expected to evince as much interest in my subject as they would naturally do in the lectures on candles or lamps delivered in this hall, but it is believed that a more general knowledge of this very interesting subject will aid in its popularization, and will bring home to many who have not yet accepted the fact, that illumination by electricity for home purposes is a reality, and that this little bulb, containing a filament which becomes incandescent by the passage of a current of electricity, has made possible and practicable a system of illumination which we who use it would gladly convince everyone is superior from a sanitary and economical point of view to any other known means. A great deal too much that is unreasoning has been said here and elsewhere as to these advantages. Allow me for a short space to draw attention to some points connected therewith. When the glow lamp was first introduced, its promoters misled the public judgment and eye by claiming for it more duty than it was able to perform. It was shown in exhibitions, where each exhibitor vied with each other in one direction, namely, in creating a blaze of light, where the little glow lamp was placed alongside the powerful and intense brilliancy of the arc electric light. The exhibition of lamps of 16 to 20 candle-power in groups became the custom, and the public was unconsciously led to compare these, in their minds, with gas jets and Argand burners of far lower real candle-power. When they went further in their inquiries with the view to practical adoption, they were immediately met by the inequality of cost, which although in the first instance is due to the outlay in plant for supplying electricity is heavily weighted with a factor arising out of this want of consideration of the relative candle-power of the lamps and other means of lighting. Born and educated in the use of illuminants which present to the eye a soft wide gaseous flame, having a measurable iridescent surface containing incandescent particles widely dispersed, we were quite unprepared to estimate the increased power of the brilliant little line of intense incandescence that meets our view when we regard this glow lamp. Those with eyes able to bear its penetrating effects hailed it as a means of increasing light, regardless of the extravagance in using more than they actually required; and those with sensitive retina submitted to it as preferable to the overpowering glare of the arc.

From its use in exhibitions, and with the traditions of the gasfitter, electric light crept into our places of public resort, and thence into our dwelling rooms. Wherever one went, either the gasfittings were made the supports of the glow lamp, or it was hung from the ceiling, so that on entering a room lighted by a number of these pendants a brilliant line of light cut the eyes like the blow of a whip lash, rendering everything for a time obscure. Indeed, from careful study of places lighted with the glow lamp, I have come to the conclusion that the eye is much longer recovering the effects of this sudden slight paralysis of its light receptive powers than is supposed; and that this cry of more light which one hears, where the subject has been dealt with from a gasfitter's point of view, is simply due to temporary observation and loss of power to discover the true needs for illumination of the surrounding objects. In more than one club in London, where the lines I have referred to have been followed in applying electric light, although the candle-power of the latter is about three times the value of that of the lamps previously in use, there is a constant outcry from the young eyes that "there is not enough light," and from the old eyes "they know not where to go to avoid the glare." Of the remedies suggested for this, I cannot subscribe to one which has emanated from a well-known architect which has come to my notice, namely, that as the position of the sun, our illuminant by day, is overhead and high up, out of the ordinary direction of vision, so we ought to make use of electric lights by placing them high up in our rooms, and increase their power and number, in order to make up for the loss of light due to distance. Hence the introduction of glow lamps into the ornaments of the frieze at a well-known restaurant, and their substitution for gas jets, lamps, and candles in chandeliers and sunlights. When regarding this question from the point of view of economy, we see the reason why the cost of electric lighting has so much deterred its use in competition with cheap gas; at the same time the still cheaper arc electric light is ignored or condemned. The screening of glow lamps from direct vision adds still further to the cost of lighting, but if arc lamps were more used their cheapness would allow of much light being wasted in concealing their brilliancy by deriving the light only from reflecting surfaces. The efficiency of arc lamps is now so well secured that the old objections to them should fast disappear. That concerning the so-called ghostliness of the light has been completely dispelled by the experiments of Captain Abney and others on the subject of the color of the electric light.

The conclusions I have come to, after visiting electric light installations at home and in many parts of the continent, are that with all kinds of electric lamps used in interiors, the eye ought never to be allowed to meet the source of light, even when subdued 30 per cent. by transmission through obscuring media; that arc lamps should be employed in all large spaces, placed well overhead, and as much as possible so that their rays shall meet the eye of the uplooker by reflection only; that glow lamps should be invariably shaded from the eye, and so placed as to be as near as possible to the object to be seen—for instance on brackets attached to the frames of pictures with opaque reflectors; for dining tables with white table cloths, well concealed in nearly opaque shades, for reading or writing, small candle-power lamps are ample and least injurious to the eye if concealed in opaque shades suspended from curved table stands about twelve inches from the paper. For general illumination of rooms the shades may be more or less semi-opaque, but the reflectors or diffusers should be as brilliant as possible. Lately, the Council of the Royal Albert Hall has been making a few experiments in the distribution of light within that noble building. Both arc and glow lamps have been tried; the former in the upper, the latter in the lower part of the hall. With the arcs it was found that only in the upper arcade could they be concealed from the eyes of the audience. The effect of brilliantly lighting it up with twelve 2,000 candle-power arcs was good; but the light reflected into the body of the hall by the back wall was probably only one-tenth of that yielded. Six more such lamps placed high up in the lantern were of no more use than moonlight would have been; but when lowered below the level of the cornice gave directly or by reflection their full effect. When all the eighteen were suspended in a group and let well down into the body of the hall, the illuminating effect on objects was inferior to that of the thirty-two gas pendants, each with sixty gas jets, which are suspended all round the hall just above the arcade; but when one turned the back to the light the same print was equally easily deciphered.

What the effect of diffusing the light of such a group would have been, if the lamps had been confined in an obscured glass lantern, remains to be proved. Advocates of concentration and of dispersion of the arc lamps were found; but when it came to the concentration or dispersion of the glow lamps used in the trial, there was little difference of opinion as to the good effect of throwing the light from them towards the backs of the boxes, by placing them under the ceilings of each box, and concealing them from the eye of the audience. Some will recall the gloomy cavernous effect of the three tiers of boxes at the Royal Albert Hall; lighted up, as some of them were for the trial I am describing, the scene was pronounced fairy-like. The lights were placed so as to be of no inconvenience to the occupants; but the effect was to lighten the whole aspect of the elevation, and as every lamp was concealed, the eye could dwell on features of construction and color which before were no more than masses of shade. This concealment of the glow lamps was also carried out on the orchestra stage under the organ, where the trial was equally successful in demonstrating the fact that, although the loss of light may be considerable, by following such a course that loss is a gain when it can be proved (of which there is no doubt) that the eye is far better able to examine the objects around the concealed lights than if they were exposed. It is curious how in theaters this theory of the advantage of concealment of light is carried out on one side of the house and not on another. At Buda Pesth I saw this well exemplified, where a large theater was being lately lighted by electricity. Above the stage, and concealed among the suspended scenery, were seven treble rows of twenty glow lamps arranged so as to be altered, raised and lowered in various ways; but, alike with the footlights, not one could be seen by the audience; whilst in the auditorium itself the gasfitter again resumed his sway, and between chandeliers and brackets on the fronts of the boxes and galleries, the lights were successfully placed so that the dazzled eye could not dwell for a moment on the beauties, either physical or decorative, of a very beautiful building, crowded with an audience which came as much to be seen as to see. A very simple example will enable you to realize what most who have thought of these matters well understand, namely, the entirely different conditions which are being dealt with in using candles, lamps or electric glow lamps. Photometrically each of these yield light of the value of about ten candles; but how different is the impression on the eye. Does it not show that these must be dealt with and employed differently in their use for illuminating our hours of darkness, and to meet our various wants? Because artists love and seize on the effects of highly contrasting light and shade to perpetuate striking scenes, there is no reason why we should live under such conditions. Though a beautifully dressed woman may appear to great advantage for a minute under a brilliant flood of light, she would, I think, sacrifice the full effect of her splendor rather than always remain long under its influence.

One might go on for ever with examples of this kind. The real cause of so much difference of opinion on the question probably lies in the varying conditions of the human eye in respect to its sensitiveness of light, and its power to recoil from its effects before temporary injury has been done to it.

From the manufacturing point of view, the glow lamp consists of three distinct parts, namely, the filament, the wire mount or conductor, the glass bulb. The amount of research and experiment which has led to the perfection which now we may safely say exists in these three has been very large. It would be invidious to particularize individual labors, and the list would be too long to occupy the time of the present occasion. The burner, or bridge, has been the subject of a large part of these labors. The conditions which it should fulfil are various, and a good filament for the purpose has been produced from various materials. But the object of most inventors has been to find a highly refractory substance, and they have all ended in using carbon of either a fibrous or amorphous consistency, which they produce in the shape and of the nature which they require, by various processes. The conditions of form, density, uniformity of section, surface and electrical resistance, with which a glow lamp bridge must be endowed are now well understood. First, the form has been governed by the need to hold within a bulb of a given size a carbon wire of a given length. The simplest example of the means resorted to to achieve this is shown in this lamp, in which it will be seen that by giving the filament a coil, one of about seven inches in length is contained in a bulb only three inches in length, without unduly approaching the glass. Another condition of form is that of uniformity of section. With some of the raw materials used, it is almost impossible to obtain this in the early preparation without gauging them in a die, by means of which the irregularities of surface are scraped off before the thread or strip is bent into form previous to baking. This is the case with the material of the Edison filament, of the preparations of which, from especially-selected bamboo in all its stages, we have seen beautiful examples at the Paris and Crystal Palace Electric Exhibitions. It is not the case with the filaments prepared by squirting a viscous solution of cellulose into a precipitating solution, a process which produces at once the most perfect uniformity of section, such as that used for making the filaments, for instance, of the Victoria Brush glow lamp. It will be at once understood that the after stage of depositing carbon by the process discovered by Marcel Deprez is not essential to the obtaining of such uniformity in the latter case as it is in that of other inventors, who carve it out of raw vegetable material of either a fibrous nature or out of strips of paper or parchment. Most of these raw materials are by way of being trade secrets; indeed, in the case of one glow lamp maker on the Continent, I know that the inventor has never divulged his secret, and that he prepares the raw material in the privacy of home, and brings it to the works in such a form as almost to defy detection of its origin.

The raw material is generally wound on to blocks of carbon, and then baked at high temperatures. Here, again, we have a stage in the preparation of filaments which has given rise to a great deal of labor and research. The reasons for the varying results obtained from bakings were at first very obscure. With some kind of materials, filaments off the same blocks, and off different blocks, showed differences of contraction, causing fracture in the process, differences of tensile strength, and of surface, for which it was difficult to account.

Various means were adopted to regulate the rate of increase and decrease of the temperature in the oven, to exclude oxygen from contact with the baking, and the results as often misled the engineer as they helped to bring him to the desired standard process. All who have been through this will bear witness to how often they were disappointed, and how only, by slow, steady, and patient investigations and collaborations of results they at length were able to deduce the conclusions which have led them to the true path which must be followed in the preparation and process of baking the raw material, from which they have seen no reason since to depart. To produce a carbon more or less dense and uniform has been the object of all, but if I have been understood, it is obvious that I attach the most importance to that process by which sufficient density and uniformity of section and surface are actually reached at this stage of the preparations of the filament.

We now have to study a stage which may be regarded as the most important with reference to the commercial use of the glow

lamp. So early as 1878 it was discovered, or revealed, that in order to be able to use a large number of glow lamps on one system they must all be subject to the same electrical conditions of tension. It was found that it would be impossible to maintain uniform illumination in all the glow lamps on a system if each lamp was to be subject to different conditions of pressure; and that the only way to achieve a practical result was to connect one terminal of all the lamps to a main conductor conveying a current in the first place sufficient for all the lamps destined to be used in the system, and in the second place having an E. M. F. or potential above zero (zero being an empirical "earth"), of an energy suitable to bring the filament to a state of incandescence; and so arrange that the value of the E. M. F. should be the same throughout.

In other words, the system of distribution known as the parallel system was thus practically discovered. The second or return conducting path is, of course, necessary when dealing with a physical development of energy such as what we call "electricity," to complete the circuit to the so-called negative terminal of the dynamo, or other source.

It will readily be appreciated that the word "parallel" is a misnomer, the parallelism of the conductors having nothing to do with efficiency; and that their being carried alongside of one another throughout a building only arises out of a desire to economise the labor of the workmen who have to put them up.

It would, I conceive, be well if the public, and above all the insurance companies (for it is largely a question of fire risk), could be brought to understand that the second or return wire is electrically the same as the "earth" of the electrician, and that so long as the positive, or supply wire, is well insulated and kept far apart from the negative, or return wire, no further precautions are necessary; and when they are thus far apart, even if one is bare, greater security is obtained than by the present system, which unreasonably insulates the wire which need not be in a state of electrical tension, as well as that which is always ready to discharge I have digressed a little way to show why absolute uniformity in the glow lamps is necessary to such a system; nothing in its condition could be made to compensate for any defect in that respect. The chief aim, then, must be to secure this uniformity in the manufacture of the filaments of glow lamps.

Gas and Electricity from the Gas Interest Standpoint—They Weaken at Last.

Our contemporary, *Light, Heat, and Power*, of Philadelphia, an able monthly journal representing the gas interests, publishes in its last issue the following editorial. Our comments will follow later on.

"In one respect the recent meeting of the American Gas Light Association fell far short of what should have been. There was no discussion, worthy the name, upon the greatest living question before the gas world—the present and future bearing of the electrical interests upon the gas interests. There was a studied attempt to pass the great question, and it was passed, well-nigh silently. There was a laughing attack made upon the photometric power of the electric incandescents, in the talk ensuing Mr. Boardman's able paper, but even this was quickly turned into an attack upon another interest. The greatest question with which the Association should have grappled was left alone.

Such treatment of a living issue comes only from one of two causes—apathy or fear. Either of these is inexcusable. Properly introduced and properly handled, the discussion of the relations which the two interests bear and are to bear towards each other, would have been most fruitful in good results. The experience of some would have well served for the future guidance of others, and the hunger of many a weaker brother been allayed by the crumbs of wisdom and good advice that would have dropped from the lips of those who knew. It was a poor plan that shelved this matter for things of lesser importance.

"For the question is one that must be largely met and decided upon before the ten months roll around that lead to another meeting of the American Association. The coming year will see far greater progress made by the electrical interests than the sage and sober chronicles of 'electrical accidents' are dreaming of. Inroads into the gas fields will be made to serious extent, unless such be promptly and efficiently met. How to meet these is the question on which the experienced members of the American Association should have advised their brethren. The work undone has been left to others, and so far as devolves the duty on us, we are determined that every gas man who reads shall know his danger and the way of escape.

"There is a way of escape that is both honorable and, in most instances, easy. This is to recognize the lighting interests as one, and, instead of entering into a combat that will probably end in mutual disaster, to enter into a compact that shall jointly serve the twin interests.

"There is no need of repeating old arguments here. It is common fact that the electric arc, at least, largely helps the domestic consumption of gas, and in many cases, where the street lighting has been lost to a gas company, its annual output has still shown a larger increase than in any previous years. How much better, in such cases, to make this increase in output, and still own the street lighting plant! It takes little reason on the part of those who can reason to see the clearness of this. Nor does it take much more reason to see the way to such consummation.

"The electric lighting companies are antagonistic to the gas interests, in a great measure, because the latter originally forced such a condition of things. There are those, supposably interested in the well-doing of the gas companies of the country, who have been holding their rushlight so close to the eyes of many of the older gas managers that the latter have failed to see clearly beyond, and have trusted in the assertions of a big breath that it would yet prove an easy manner to whistle electricity down the wind. As we have had occasion to say before, air gas will not do as a means wherewith to combat electricity, and wind alone is a poor weapon. The misguided gas managers are finding this out, and, with purpose well concealed, there are to-day not a few who have openly denounced the electric light, furtively making terms for that union of interests in their own cases that we openly advocate for all.

"The electrical managers are becoming aware of the benefits arising from a union of interests, and they will not be slow to embrace fair opportunities. But we do not advise such a union as will necessitate a vast watering of stock and a holding up of a high price for gas to secure payment of dividends on fictitious values. There are instances wherein such procedures are, in greater or less extent, necessary; but these are the exceptions and not the rule. What we advocate is the installation, on the part of every gas company of its own electrical plant. Begin first with an arc system, following up, as convenience may dictate, with the smaller lamps, thus giving consumers the choice of means for illumination and holding all the vantage ground within the company's grasp. In very many cases this can be accomplished without inflation of stock, or issue of bonds; and we need not state the effect upon the dividend-earning power of such a company.

"Will the electrical interests fall in with such a plan? Well, where they do not, a contest between an established gas company and a newly organized electric lighting company, for the electric lighting of a city or town, would last only until the latter company tired of a losing game. But the answer to the question can be more plainly given. The electrical interests will fall in. Our news columns show that one electrical company has taken advanced ground upon the question, and not only is openly working in union with the gas companies, but has secured some of the latter as its sectional agents. No one will question the fealty of the leading spirit of the St. Paul Gas Light Company, and this company is acting as the agent of the American Electrical Manufacturing Company, for the Northwest. It is due to Mr. Goff, President of the American Company, to say that this plan of a complete union of the gas and electrical interests is original with him, and that he is thus far alone in his advanced position, but he cannot so remain. His success has been so marked and his mode of approaching the gas companies so free from threats or demands, that the roll of companies that are falling in with his proposition, as published from time to time, must needs induce others to follow in the path he has marked out. Some of these will have to change their methods considerably to be able to approach with plausibility the gas companies they are now antagonizing; but the changes will be made, and we shall see the olive branch held out all along the line.

"Will the gas companies accept? The wise ones will; the foolish will—do as they please. The future of many a gas company lies largely in the decision of this problem during the coming year. We believe there is but one way to meet this question, where such a way is possible, and there are few cases wherein it is not possible.

"One thing is certain. The gas interests shall know what can be done, and none of the 'might have beens' shall be traced to default of ours. We are here to remain, and the flag we raise is the banner of peace and prosperity for the interest we represent. We have no fear but that the progressive men of the gas fraternity will aid us in our endeavors to turn a common woe into a common weal."

Incandescent Lamp Manufacture.

The early workers in the field seem to have used retort carbon sawn into thin strips. The fault was, of course, that the carbons were not of uniform resistance, and the processes of manufacture were too difficult.

Coming down to modern times, we find Sawyer, or Sawyer and Man, composing hydro-carbons by heat, and utilizing the deposited carbon. They used a thin piece of willow charcoal as nucleus, and deposited a thick coating on it, by electrically heating it under such liquids as alcohol and olive oil. The carbon was used as so made, or the deposited carbon was removed from one side, so as to expose the willow charcoal, and the charcoal was then scooped out, leaving a sort of crescent sectioned or boat-shaped conductor. This process is fully described in "Electric Lighting," by Sawyer (Nostrand & Spon, 1881), so there is little use in describing it here. Sawyer's lamp was at that time a very primitive apparatus, and his method of making carbons has never come into general use. However, as this has been, and may soon again become a matter of litigation, the point had better not be discussed here.

Carbon deposited by decomposition of such bodies as oil, alcohol, or hydro-carbon, seems to be almost a distinct allotropic modification of that element. Charcoal raised to a very high temperature, acquires the same, or almost the same, properties, so these properties, no doubt, result from the high temperature, and not from the source of the carbon. Among these properties are high electrical and thermal conductivity, hardness, incombustibility below a very high temperature, and inability to occlude much gas.

Carbon deposited by decomposition of hydro-carbons seems always to be nodulous, even if deposited slowly at very high temperatures.

Jameson, of Newcastle, has worked at deposited carbon. His plan was to deposit it inside glazed porcelain tubes, and to turn the carbon conductors out of the resulting carbon tubes, like little piston rings He abandoned these experiments, either because they did not look promising or because his time was too fully occupied in working out his coke process.

If a gaseous hydro-carbon is rapidly decomposed by heat, the carbon is deposited in tufts of fine black hairs. Messrs. Hughes, Maxwell, Rowland and Chambers have lately been working at deposited carbons. One of their methods is to make these carbon hairs artificially for use in incandescent lamps. These carbon hairs are sometimes produced in great quantities, and of great length, in coke ovens. Either Mr. Cookson or Mr. Jameson gave the writer a box of these carbon hairs, to try as lamp carbons, in the spring of 1883. Unfortunately, the hairs were too crooked and too uneven and unmanageable for use, and were not tried.

The Cruto lamp is made by heating a very fine platinum wire electrically in an atmosphere of some gaseous compound of carbon. The process is very interesting, but is somewhat difficult, as the platinum must be raised to a temperature very close to its melting point in order to decompose the gas. The writer has no special experience of this kind of manufacture, so he cannot give any information beyond that published on the subject. A short account of the manufacture of Cruto lamps has already appeared in the electrical papers. It has sometimes been said that the Cruto lamp is superior to others, because it has a hollow carbon. In the chapters on testing, and on the theory of the incandescent lamp, it will be shown that this reasoning is fallacious. The chief method in this method of making carbons is that they are of such low specific resistance that a carbon has to be made very long and thin to give, say, fifteen or twenty candles at, say, 100 volts. This lamp, on the other hand, should be very well adapted for low resistance or series work as it is difficult to make a carbon by other methods which will take several amperes without being inconveniently thick. The Cruto carbons have a beautiful finish.

Messrs. Boullon, Probert and Soward have made very thin carbons by a curious process. They pass induction coil sparks between two points in a hydro-carbon atmosphere. This decomposes the hydro-carbon, and builds up a very fine carbon thread. The electrodes are made to recede as the carbon is formed. Some short carbons prepared by this method were given to the writer by Mr Probert. They were so exceedingly fine, however, that they could not be easily mounted. The extreme fineness also made them unsuitable for anything but lamps of very small candle-power, as it would have taken some feet to make an ordinary lamp, and such a length would not have supported its own weight.

The writer has tried some experiments with the view of depositing carbon on metal wires so as eventually to get rid of the metal, but without success. Fine iron wires were heated electrically in an atmosphere of carbon disulphide. When any part of the wire became red hot, it was attacked so vigorously by the sulphur that it fused at that point. Of course, immediately the iron was partially converted into sulphide the resistance at the part attacked increased. The same thing happened when the experiment was tried in an imperfect vacuum. Even if the whole of the iron were converted into sulphide with carbon deposited throughout, there might be difficulty in getting rid by volatilization or otherwise of the sulphide.

A similar experiment was tried with carbon tetrachloride instead of sulphide, but with no better results. The chlorides of most of the metals are volatile. It would be interesting to see whether carbons could be made by these means, a furnace being used instead of electrical heating.—*London Electrician.*

* * The New York Electric Line Company desire to substitute an attorney in the place of Mr. Roger Foster, present counsel. Mr. Foster claims a due of $3,500 counsel fees and disbursements. A very wordy tilt took place recently in the Chambers of Common Pleas Court over this matter, and the judge reserved his decision.

Munich and Augsburg have recently been connected by telephone lines.

L'Etoile Belge says that telephonic communication will be established between Paris and Brussels sometime in January.

ELECTRICAL REVIEW

Published at 23 Park Row.
P. O. BOX 3329.

GEO. WORTHINGTON, - - - Editor
CHARLES W. PRICE, Associate "
LOREN N. DOWNS, President.
ANDREW J. DAM, - Vice-Pres't and Treas.
C. C. HASKINS,)
GEO. A. HAMILTON, - Consulting Electricians.
GEO. H. BENJAMIN,)

SUBSCRIPTION
United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.
Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

Frank M. Gilley, 54 Equitable Building, Boston, Mass., is our New England representative.
Mr. C. C Haskins, 118 LaSalle Street, Chicago, Ill, will represent the REVIEW in the West
Messrs. Wm. Dawson & Sons, 121 Cannon Street, London, England, are our representatives for Great Britain.

NEW YORK, JANUARY 1, 1887.

CONTENTS.

	PAGE
Plant for Storage Batteries	1
Glow Lamps, Their Use and Manufacture	2, 3
Gas and Electricity from the Gas Interest Standpoint—They Weaken at Last	3
Incandescent Lamp Manufacture	3
National Electric Light Association	4
Retained or Detached	4
The Reign of Law and Reason	4
Chicago Electrical News	4
Boston Electrical News	5
Practical Information	5
Telephonic News	6
Telephone Relays	6
The Condenser on Telephone Circuits—An Erroneous Conclusion	6
Underground Wires in Broadway	6
Philadelphia Telegraph Service	6
Mr. Warner's Report on the Testimony Taken by the Railway and Telegraphic Subsidy Committee	7
How Chicago Sends Messages to Everybody and Everywhere	7
Telegraphic	7
Electrical Science	8
Behavior of Metals and Metallic Compounds in Electric Currents	8
Digest of U. S. Patents on Storage Batteries	9
A St. Louis Man Suggests a Solution of the Street Wire Problem	9
An Editor's Use of Electricity	9
Electric Light News	9
Electrical Patents	10

The iron of an electro-magnet when the current has ceased passing through the coils does not immediately lose its magnetic power. And this is strikingly so when a piece of soft iron is allowed to remain across the poles of the magnet. Of the iron of the electro-magnet a considerable amount of magnetism will be permanently retained. Carefully made apparatus contains provisions whereby the armature is not allowed to touch the poles of the magnet. The "remaining," or, as it is called residual magnetism, has but little effect. The writer remembers an automatic gas burner which failed to light. When examined it was found that the armature which shut off the gas was held attracted to the poles of one electro magnet. The placing of a sheet of paper on the face of the armature entirely solved the difficulty.

Interest in the so-called muscle or mind reading has begun to ebb. We shall have to wait until the society for Psychical Research has an opportunity to report. It used to be wondered why anything you may be hunting for is invisible, even when under your nose. This is explained on account of the blind spot where the optic nerve joins the retina of the eye. It has been insinuated that certain electric light men have an unusual swelling in this spot when attention is called to any defect or insufficiency in their system. The Society for Psychical Research are next to investigate the cause for the feverish pulse of the gas meter. Other subjects suggested for their study are the origin of the word Hell-o and the reason for high resistance on a private line with many subscribers when two are talking some gossip. It is reported that a member of the society has discovered that by undulatory currents in the rods of corti were perceived audible speech. A preliminary will be applied for at once.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The executive committee of this rapidly growing association held a very satisfactory meeting in Philadelphia last week, and perfected arrangements for the next semi-annual convention. It was decided to hold the convention at the Hotel Lafayette in Philadelphia, February 15th being selected as the date for beginning the sessions. Special arrangements have been made with the hotel authorities, and all who attend are assured of first-class entertainment. Mr. A. J. De Camp, 2011 Johnson street, Philadelphia, the chairman of the executive committee, will answer all inquiries.

Philadelphia is conveniently located for the majority of the electric lighting fraternity, and we expect to see the largest attendance at the February meeting—the fifth in the life of the association—of any yet held. The hotel is admirably located, being but a few steps from the Broad street railway depot.

RETAINED OR DETACHED.

In one of the most widely known institutions of advanced instruction in this country a member of a class asked in accordance with a common custom at such institutions a question (in this case such a question as he certainly had a right to ask and one to which he had a right to receive an answer). The Professor replied, smiling naively, that he could not answer the question as he was retained by the ——— Company. Many pertinent questions are in a like manner evaded where the instructor is not forced to admit that he is tied to some corporation's apron strings. Shall a question relating to the manufacturers of carbonic acid gas bring to the enquiring student the reply that his teacher is bottled up by the Xlytel Bottling Company, or boxed up by the Mikado Baking Powder Company? Is an inquiring student when asking about the insulating properties of asphaltum to learn that the learned professor who sits before him as large as life and twice as natural is buried by some underground company?

Higher institutions for learning are endowed by the State or national governments or by private individuals. That in these institutions professors or teachers are sold body and soul to the interests of outside corporations is in direct violation of the spirit and intent of the endowments of these institutions. It has been clearly proved schools for advanced instruction cannot be supported by the fees of the students. Outside aid is absolutely necessary. There is hardly a college or scientific school in this country that is not greatly in need of ready money. Would much be given to endow certain professorships if it were known that the incumbent was retained by a number of companies and his time to a great extent spent in working for them and testifying in their behalf? Can such a professor have time for research or add to our knowledge of science? America is far enough behind in the numbers devoted to the advancement of our knowledge of pure science, though every professor and teacher be an investigator. We recall the stinging rebuke Prof. Rowland gave some years ago to the quasi professors of science who were for advancement—of their own pecuniary interests.

Perhaps some excuses may be made for the present state of things on account of the small salaries paid to professors in our higher institutions. Their salaries should be increased and the positions made so attractive that men of ability could devote their whole time and energy to the study of the subjects to which they are assigned.

THE REIGN OF LAW AND REASON.

Continued experimentation with its consequent discussion has at last brought the electrical subway question down to the comprehension of all but those who don't want to understand it, and those whose intellectual ken is too feeble to grapple with it.

Our ancient friend Herod has divided the human family into three classes; those who are unfamiliar with the truth, but who can recognize it when it is pointed out to them; those who know the truth and follow in its path; those who can neither find the way by themselves nor will pursue it when it is pointed out to them by others. These latter, he says, have neither perception nor docility—and the only excuse for regarding them as above the common animals is because God made them. The proof we have that such people exist is found in the fact that, notwithstanding it has been repeatedly shown that the electric light wires may not safely be buried alongside the telephone and telegraph wires, a certain and happily small portion of the community is still insisting that they should be. They want all the wires buried together, they want the electric companies well taxed, and they want a cheaper service. These are only a few of the things they want. We forbear to mention the other things they want because our space and our patience will not permit it.

The Electrical Subway Commission of Brooklyn, in its report to Mayor Whitney last week, brings up two very prominent objections against forcing the electric light companies, at least, to bury their wires. Here they are:

"The Board has found no device which would with certainty, in its opinion, enable the wires carrying arc light currents to be safely and successfully operated in the same conduit with telephone and telegraph conductors without disturbance or injury to the latter. Hence the consideration of the arc light conductors must have reference to independent conduits kept at a distance from the telegraph and telephone conduits. It has been a question whether the electric light companies employed to light the streets under contract with the city could be legally obliged to place their wires underground. Recently, in view of the general public interest in the subject, the Board obtained through your courtesy the opinion of the Corporation Counsel, which raises, however, for the consideration of the Board, another question, namely, if the city authorities have made contracts at a certain price for lighting the streets, could this Board properly impose upon the contractors an underground system which, though technically practicable, was financially impracticable under the terms of the contract. This would certainly bring the Board into an undesirable and mischievous attitude of conflict."

First is the scientific difficulty, and second the practical one.

That the streets were never lighted so well as at present no reasonable person will deny, yet that such lighting shall be able to continue the competition with gas, the electrical companies must be treated fairly.

It is a good thing for the public and a good thing for the electrical companies that this question of burying the wires has been brought up for discussion, and still another good thing that such intelligent men as those composing the subway commission of this city and Brooklyn should have been selected to examine and report upon the various systems of subways and conduits. Notwithstanding all the unthinking clamor that has been raised against these commissions by an unthinking press and an unthinking public, notwithstanding the charges that have been made that they were under the control of interested persons, we have not seen the slightest evidence to prove complicity or venality, and this being the case it would seem as if those who made the charges owe these gentlemen an apology.

The electric railway in Detroit, constructed by the Detroit Electrical Works, is in constant use on a three mile suburban track, and is giving complete satisfaction. The motor is the invention of Mr. Frank E. Fisher, electrician and superintendent of the Electrical Works, and is run from a Western Electric dynamo. The third rail system is used, the motor being attached beneath the car. The gearing is particularly neat and effective, and is undoubtedly the work of a thorough mechanic as well as electrician. The car makes hourly trips during the day in all kinds of weather, and in hauling capacity and speed has proven most efficient.

CHICAGO ELECTRICAL NEWS.

In the Brussells telephone exchange subscribers who desire to be awakened at a given hour in the morning, are now rung up from the central office. The fact is published as something new. This plan was in vogue in Chicago, under the A. D. T. management, some seven years ago. The thing worked well until one morning, by an unlucky connection, the druggist's clerk, who was to be called, overslept himself, and a drunken night watchman was wakened at four o'clock in the morning, much to his disgust. The complications arising from the error rather discouraged the continuance of the system. The clerk was discharged for oversleeping; the watchman for sleeping at all, while the evidence against the operator went to prove that he was half asleep also, and he went. It was a case of three of a kind.

The principal of the High School at Decatur, Ill., has classified ten different species of birds among the thousand or so which have been killed by the dazzling of their sight by the electric lights. These are placed on towers, and the night migrating birds, which fly sufficiently high to escape ordinary obstructions, are attracted and caught by these tower lights.

The stations in National Park are now connected by telephone with Livingston. Parties in charge of hotels and property at Great Falls, Upper and Lower Geyser Basins, and Morris Geyser Basin, will thus be enabled to keep up a speaking acquaintance with the shore and with each other while sojourning in the sea of snow during the winter, when other communication will be next to or quite impossible.

A Chicago inventor has brought out an electric permutation lock for safes, which has some very marked peculiarities.

There is no hole to speak of in the face of the safe. The dial has no connection with the body of the safe in this invention, except through electricity. The safe may be anywhere, and the lock may be left at home, or almost anywhere else—the distance between the two only seems to be governed by the possibility of working the electrical wires connecting the two parts of the apparatus.

The mechanism is simple. The dial rests in a magnetic block, from which wires extend and through magnets set up the tumblers in the lock, to permit the bolt bar to be moved, and this movement releases a spring or compressed air, which throws the bolts. The wires enter the safe in such a manner, and their devious windings are such, that they are not likely to be tampered with—when such action on the part of the burglar can be of no service to him in his nefarious designs. There are no outside projections to saw off, no indications of any nature on the outside of the lock to guide the burglar.

The same gentleman has made an invention still simpler than his safe lock, and one in which there is a more ready return than in the above, and, like a sensible inventor, he has gone to manufacturing a superior article of watch and clock springs by a process which produces not only a first-class article, but produces a better article for the same cost than the present plan.

If there were an electrical almanac made, among the forecasts in the neighborhood of the latter portion of that page where Capricornus reigns, and the last month is designated by a poor, shivering old pilgrim, we would probably read: "About this time look out for telephone suits."

There is a sort of a tempest in a teapot among the Inter-State people here.

Edward A. Platt has filed a long bill against that company. He says the capital stock of the company is $500,000. Dissensions among the stockholders are threatening to destroy the business. The company is involved in important litigations with the Bell Company. Latterly, after a new secretary was elected, the old secretary locked up the vaults and disappeared, and the vault

has not since been opened. There is also $90,000 treasury stock which he says the directors are preparing to dispose of for the benefit of the few; and he says that on the 20th some one entered the company's office and removed the carpets, desks, furniture and instruments. He charges conspiracy and asks that a receiver be appointed. Judge Tuley enjoined the directors from selling until the matter could be investigated.

Then A. C. Story, attorney, began suit also for $20,000 against the same company. In an interview he said, "I don't know whether the company is in trouble or not. They owe me about $15,000 for professional services. I was their solicitor for three years, and never got a cent. I saw two or three suits had been commenced, so I joined the procession. I used to own some stock, or, rather my son did, and Whitlock, the President, said he would dispose of it, as he was getting rid of his own, and agreed to get the same price as for his own. He sold our stock for fifty cents, and Jo. Reynolds and Mr. Bines, to whom he sold and of whom he collected the money, claimed that he had been acting as their agent, and wanted the difference between 15 and 50 cents. Then I tied up the stock with an injunction, and the matter is still pending. I don't know as anything is the matter with the company, but I don't want to get left."

The Electrical Supply Company of this city has recently installed a sixty light arc plant at St. Charles, Mo., for the Guernsey-Scudder Electric Light Company, St. Louis.

The system used in the Excelsior, and so far as heard from, the plant, is giving eminent satisfaction. The Electrical Supply Company are also wiring the State Capitol at Springfield, Illinois, for a forty light arc plant for the Springfield Company.

There is more or less chance for considerable hard digging with running vocal accompaniments in that capitol building. They want the wires all hidden, of course, and the building is a fire proof structure, with iron, concrete, stone, cement, tile, and sich, everywhere and always. The job is not an enviable one for a mild mannered man.

The Fort Wayne Jenney people—Chicago agency—which means W. J. Buckley—have just put in sixty arc lights in the Armour Packing Company's establishment Kansas City, and an additional 16 lights at M Lassig's Bridge Works here. They have also replaced part of an existing plant at Gossage & Company's dry goods house on State street, with a dynamo and thirty lamps, of their own system.

The Buffalo *Courier* of a few days ago tells how the Postal Telegraph Company worked a long circuit. The operator related that he read direct conversation between Vice President Henry Rosener, at New Westminster on the Pacific Coast, opposite Vancouver's Island, and President Chandler, in his office at 187 Broadway, New York. The route, some 3,000 miles in length, was via. Buffalo, Toronto and the Canadian Pacific. Every few minutes Medicine Hat would chip in and all the operators seemed to be on hand, and anxious.

That Buffalo and Toronto line is the route where several of the old-time operators did their first work. Among these was Henry W., commonly known as Hank, Faxon. Hank undertook, in the earlier part of his life, to be a sailor; but there was too much tar and trouble in the business. In 1846 or '7 he drifted into telegraphy, under the guidance of Dave Kissock, Charley Wells and O. E. Wood, where, like all the rest of us, he about half belonged to the Canada and half to the New York line, cleaned battery, mended line and ran races with freight trains on a three-wheeled hand car, or delivered messages, as occasion required. Henry was the originator of the pictorial representation of "D. H.," on the envelope covering free messages. Sometimes it was a human, and at other times an animal's skull, but always perfect as a sketch.

He was the first in the field after Alfred Vail with a purely telegraphic literary effort, in the "Adventures of Mr. Hitt, in Search of a Circuit"—a manuscript book well illustrated with pensketches, founded on the misfortunes of an operator hunting a break in the line. He also wrote the "Proceedings of a Telegrapher's Convention," which was a source of much amusement among the craft. After telegraphy he became one of the writers on the Buffalo *Republic*, where he advertised that Blondin—it was said at the time, without the knowledge of that gentleman—would walk across the Niagara, upon a tight rope. Blondin assumed, and really seemed much astonished, when he saw the statement, and remarked that "she was imposs." It was engineered though, however, and Blondin retrieved his broken fortunes by the act.

Henry was the father of the Silver Lake snake scheme, by which the landlord of that resort made an immense amount of money, and the paper—which was up to that time comparatively unknown, save at the evening firesides of the average Buffalo stay-at-home citizens—quite famous. An actual piece of mechanism, representing a hideous sea snake was manufactured and sunk in the lake, connected by wires to the hotel, so that it could be seen to move in the water, which was deep enough to prevent its being very closely scanned. It could also be made to rise to the surface, which it did on one occasion when Horace Greeley "pulled for the shore," and went by first train to New York to write up a page or so of the *Tribune*, in confirmation of the stories told.

When the summer days were over, when the snows began to fly, the ice formed over the lake, the wires rusted off, and the secret, too good to keep any longer, leaked out. The serpent was dead.

Henry's friends have always claimed, and with much show of truth, that he was the great, original, and only author of "Beautiful Snow."

CHICAGO,, Dec. 27.

BOSTON ELECTRICAL NEWS.

The fact that the day before Christmas the horse cars were less crowded than on previous years, has been noticed by the daily papers, which, however, demand immediate action in the matter of rapid transit.

While speaking of railroads, a new device for electrical railroads is being placed on the Boston market, and a few blocks of stock have been unloaded. This is the way they work it: The would-be purchaser of the stock is shown a number of patents, genuine and strong, covering the principle of interrupting the current to a number of motors on a line in parallel. Then the claim is made that electric railroads, though a success at present, in *no* case run more than two cars on a track at the same time for the reason that the two take all the current, or, in other words, short circuit the line. Granting this, the value of the invention becomes a proven fact. Visions of immense profit then come out to view. On the Daft road at Baltimore, Md., more than two cars have been run at a time, and as for stationary motors, there are parallel circuits on which there are more than this number in operation. In running incandescent lamps in multiple arcs, why do not the first two lamps take all the current? A number of railroads are said to be in process of construction which are to be equipped with this system. The total plant of the company at present is a wooden cylindrical block painted black in sections to represent insulated portions.

The Waterbury Arc Light Company have decided to extend their business, and have ordered Edison dynamos and complete apparatus for 1,000 incandescent lights.

The city of Somerville was last week illuminated for the first time by arc lights from the station of the Cambridge Electric Light Company.

Night Engineer Patrick McAvoy, of the Western Union Telegraph building on State street, was presented with a nickel-plated lantern and a meerschaum pipe, by his many friends, on Christmas eve.

There has been less public complaint of the crowded condition of the horse cars in Boston, in the Christmas season just over, than usual; but the necessity of better accommodation has sunk deep into the minds of those who have used them. Boston imperatively needs more cars in those portions of the day when travel is greatest. She can get no more on the streets, perhaps, under the present system; but she should have either more streets utilized for this purpose under the old system, or a new system altogether. When will the patience of her people finally be overcome into demanding one or the other of these changes?

The reduction in fares upon cars of the Cambridge Railroad, which, it is understood, is to go into effect on January 1, applies only to way fares in Cambridge and Somerville proper. The fare between Boston and those cities is to remain at six cents. In Board of Aldermen last evening the order adopted a few weeks ago authorizing the Mayor to petition the Legislature for the enactment of a law by which the company would be compelled to reduce its fares between Cambridge and Boston to five cents, came back from the Common Council amended, "or any two points in the city of Cambridge." The order as amended was adopted.

This company increased its fare from 5 to 6 cents at the time of the general advance of conductors and drivers' wages last spring. While the Consolidated and Metropolitan roads have been investigating the subject of electric motors, the Cambridge road, the lines of which are particularly fitted to be operated by electricity, is expected to experiment with the introduction of this new form of motive power with a view of reducing their operating expenses.

Without the laws and enactments of other States and the appointments of innumerable commissions a great deal of progress in laying underground wires has been made in a quiet way. There are telegraph, telephone and electric light wires underground. A reasonable view of the whole question and one generally held in Boston is, that in the business portion of the city practically all wires should be underground. On side streets or in the residential portions of the city overhead wires may be used, especially for short lines and feeders. If the plan as followed in some recently built portions of the city were to be carried out an alley wide enough to allow a team to pass through is made adjoining the back-yards of two rows of houses facing the nearest parallel streets. Poles placed close to the fences would not be objectionable.

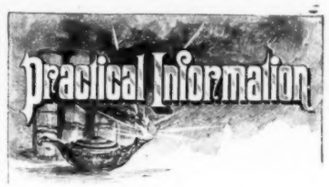
A number of batteries are soon to be brought before the public. Of one it is said that the fluids used are too strong for any vessel yet made to contain them. In fact, the much longed for liquid of the medieval alchemist must have been discovered, the universal solvent. It is hinted that several nearly bankrupt companies have given large orders for this fluid.

BOSTON, Mass., Dec. 28.

According to recent experiments water of maximum density evaporated with steam at atmospheric pressure (14.7 pounds per square inch) occupies 1644 times its former bulk.

Another dynamo is being placed in position at the Woonsocket Electric Light and Power Company's works, making five in all, three for arc lights and two for incandescent.

Mr. A. L. Ide, of the firm of A. L. Ide & Son, engine manufacturers, Springfield, Ill., was in the city last week, in conference with the officers of the American Company. Mr. Ide is president of the Electric Light Company of Springfield, using the American system of electric lighting. He gave orders for two twenty-five lighters to be shipped to his company, which will be forwarded this week. He reports the business of his company in splendid condition, and very popular in Springfield.



There are two reasons for using round in place of flat side porous cups. The latter breaks less easily and are cheaper to make.

A good battery for electrotypy consists of two or three Daniell cells of two-gallon capacity. But better still is a good electro-plating machine.

It is stated that M. Bregnet found in one instance that it was necessary to advance the commutator brushes 70° when working with a gramme dynamo machine at 1770 revolutions.

Gravitation on the sun is about 27 times as great as on the earth. If the force of gravitation here were increased to that of the sun, we should be unable to move; a 150-pound man would then weigh about two tons.

Gold leaf is cut by placing it on a flat clean leather pad, pressing it very gently, and sawing with a perfectly straight-edged clean knife or split cane. The best Dutch metal may replace the gold leaf if perfectly smooth. The Dutch metal may be cut between paper by close shearing scissors with such long blades that each cut is made with one motion.

Somebody has compared the world to a beehive. The empty comb represents the possibilities of life, which may be filled with honey, or stuffed with bee bread; and as in gathering honey, the bee uses the sting as a spatula, and mingles a portion of its sting poison with the sweet for the sake of preserving it, so the wealth which the human bee accumulates lasts all the better when deposited little at a time at an expense of much care and labor.

The electromotive force of a Grove cell rises from 1.7 to 2.4 when the dilute sulphuric acid surrounding the zinc is replaced by a concentrated solution of caustic potash. In the same form of battery the nitric acid surrounding the platinum is often mixed with strong sulphuric acid, which absorbs the water formed by the partial decomposition of the nitric acid. As fast then as the nitric acid breaks up, while the battery is running into nitrogen tetroxide and water, the water is absorbed by the sulphuric acid, leaving the nitric acid concentrated.

Replying to a query, three pounds is a heavy pull for any electro-magnet or solenoid to overcome. It could be done with one cell and an electro-magnet of very low resistance, but the cell would have to be a very large one. If a small battery be a *sine qua non*, use a lever with an iron armature on the end, made just as heavy as compatible with allowing the other end to remain in its normal position without any additional force being applied, and then arrange, say, three sets of three each of small electro-magnets, ½-inch cores wound with ½-inch thick layer of cotton or silk-covered No. 22, the fulcrum of the lever being midway, and the sets so arranged that the first one, on switching on the battery, should come into action and draw down the armature, say, ⅛-inch, thus bringing it within the range of the second set, the circuits of the first being carried through contact pieces on the lever itself, so arranged as to break contact for the first set and switch on the second set at the moment that the armature, by meeting the cores of the first set, had come within range of the second set, the third set being similarly arranged with regard to the second. In this way you could lift 3 pounds with a battery of not more than six moderate-sized bichromate or chromic acid cells, but the whole apparatus would be a complicated affair, depending for its working on exact and delicate adjustment, and any mechanical device would be preferable.

Telephonic News

*** J. L. Neitanger, formerly Central Union Telephone Manager at Piqua, O., is now manager of the A. D. T. Company at Salt Lake City.

*** The R. M. B. Telephone Company is putting up W. U. lead taped aerial cable to its exchange in Salt Lake. The company has done the same in Butte City, Montana. No. 10 hard copper has been substituted for iron wire on the line to Ogden.

*** The Sunset Company, of California, are now engaged in running a telephone wire to connect Stockton with Lathrop. The line has been extended as far as French Camp. Bantas and Tracy will next be connected with Stockton and in the spring Lodi will be reached, making a direct line from Stockton to the terminus of the Narrow-gauge railroad in Calaveras county. It is proposed, also, to run lines to Oakdale and Modesto. This company, under the able management of General Manager Sabin, has within two years past opened central offices in every town in the State of any importance.

*** A special from Tahlequah, I. T., says: "Tahlequah is now connected with the rest of the world in having a line of telephone to Muskogee connecting us with the wires. This enterprise is owned and operated by Cherokees, and the people are delighted with it. Senator Sargy Sanders, who speaks only the Cherokee language, went to the box a few days ago to see if the thing could talk Cherokee, and to his surprise it did, and he conversed with a friend at the other end. When done, he turned around and remarked that it learned to talk Cherokee awful quick. It is quite novel to our full-blood friends, and they talk about its mysteries a great deal.

*** At the meeting of the Common Council of Buffalo, the Bell Telephone Company, through Alderman Scheu, presented the following petition, which was referred to the Street Committee:

"Your petitioner, the Bell Telephone Company of Buffalo, respectfully petitions for authority to construct underground conduits in the public streets of Buffalo for the purpose of carrying and maintaining its wires therein. While no experiment has demonstrated that telegraph and telephone wires can be carried long distances underground successfully and the extent such wires may be carried underground may be yet regarded as experimental, still sufficient has been done to warrant the belief that such wires can be carried advantageously in underground conduits a distance sufficient to relieve the crowded thoroughfares of our city. Your petitioner appreciates the present crowded condition of our chief thoroughfares by the various wires and the just complaint from the public, and is ready to proceed, as soon as practicable, to lay wires underground in case you will give the proper authority."

*** Unusual interest attaches to the telephone suits which have been advanced on the docket of the Supreme Court of the United States, and upon which arguments will begin on the 24th of January next. The opening argument in these cases will for the first time bring the question of the validity of the Bell patents before the highest tribunal in the land. Although the Government is not a party to these cases, they involve the general question at issue—the validity of the Bell patents—between the American Bell Telephone Company and its dozen or more opponents and would be competitors. The Government suit—better known as the Pan-Electric suit—contains no material point not included in these advanced cases. The advanced cases consist of five appeals from decisions of United States Circuit Courts, favorable to the Bell Company, in Massachusetts, New York and Pennsylvania. These appeals, to be argued as one case, are the Dolbear, the Molecular, the Clay, the People's (known as the Drawbaugh), and the Overland. The Bell Company will be ably defended by J. J. Storrow, of Boston, and E. N. Dickerson, of New York, attorneys, who for years have thought and argued and worked for their corporate client, never suffering defeat in the numerous actions that have been brought against the Bell Company in inferior courts; while Senator Edmunds, Wheeler H. Peckham and Grosvenor P. Lowrey, of New York; Furman Shepard, of Philadelphia; Lysander Hill, of Chicago; Don M. Dickinson, of Detroit, and Causter, Browne and Maynadier, of Boston, will advocate the rights of the appellants.

Telephone Relays.

Our English namesake says that "the reduction in power which takes place in the articulation from telephone receivers when the latter are worked on a long line subject to considerable leakage naturally suggested the employment of a relay which would enable the current which actuated the receiver to be reinforced. We believe, however, that all attempts to effect what is required has hitherto proved futile. An examination of the conditions under which telephone receivers and transmitters actually work will show that failure must necessarily result; indeed it is somewhat surprising that it could be imagined that success could be achieved. If we compare the conditions under which ordinary telegraph relays and suggested telephone relays have to work, it will be seen that great differences exist. In the case of a telegraph relay, practical experience shows that a very slight pressure of the relay tongue against its contact stop serves to close the current of a battery of practically any required strength, and that the removal of the relay tongue from its contact serves to break this circuit. In fact, the pressure of a grain or two on the relay tongue will close the circuit of a battery sufficiently strong to exert a magnetizing force on a magnet equal to a pull on its armature of several pounds, and the removal of this pressure from the relay tongue will open the local circuit and remove the pull on the armature. Now it is obvious that if it were found that the few grains pressure of the tongue of the relay were only capable of closing the circuit of a very weak local battery which should give to a local magnet a magnetic force of a few grains only, then there would be no use whatever in such an arrangement. In other words, so long as the force capable of being brought locally into action does not exceed the original force which brings it into action, then nothing is gained by such a combination. Practical experience has proved most conclusively, that the intensity of the tones given out by a telephone receiver joined up on short circuit with a microphonic transmitter can never be made to exceed, or, indeed, to approach, the intensity of the sound spoken against the diaphragm of the transmitter, no matter what battery power be used. It follows, therefore, that the power with which the diaphragm of the receiver vibrates must be much less than the power which the transmitter diaphragm vibrates; in other words, a pressure of say 1 grain against the transmitter diaphragm only causes the receiver to be moved with a force of a fraction of a grain, say ½ a grain. If, therefore, this receiver diaphragm be connected to the diaphragm of another transmitter, in other words, if a relay be formed, then the force with which the diaphragm of a receiver connected to this transmitter would move, no matter what the battery power may be, would be ½ of a grain only; thus the effect of a relay would actually be to reduce, not to increase, the effect. If the variation power of a telephone transmitter were the same with every current strength, then an increase of battery power should produce a proportional increase of effect, but this is known not to be the case in transmitters as at present constructed, and unless some new departure be made it seems certain that any working on the old lines must be mere waste of time."

The Condenser on Telephone Circuits—An Erroneous Conclusion.

In a note recently presented to the *Academie des Sciences*, M. Charles Cros describes some experiments on the use of a condenser in connection with telephone circuits. Having constructed an artificial line, consisting of coils of insulated wire, connected with a commutator, by which any required number of coils in series could be placed in or out of circuit, with a pair of telephones, the author added coils until the articulation of the receiving telephone could no longer be understood. He then inserted a condenser at the middle of the line, and found that the volume of sound was at once largely augmented. M. Cros proceeds to suggest the practical application of his discovery (?) upon long lines; and then theories upon the subject with especial reference to the analogy between electric currents and fluid motion. He has further constructed an elaborate arrangement of pipes and closed chambers, whereby he obtains a mechanical analogue of the circuit in question. Without staying to examine this part of the research, it may be safely stated at once that M. Cros has entirely overlooked one most important factor, the neglect of which vitiates both his arguments and his deductions. M. Cros is dealing with alternating currents, yet he has left entirely out of sight the question of the coefficient of self-induction of the circuit. If the experiment is repeated under practical conditions—that is, upon a straight wire of sufficient length to prevent intelligible communication by virtue of its resistance pure and simple—it is tolerably certain that the introduction of a condenser would no longer have the effect described. In default of facilities for such an experiment, ordinary resistance coils, wound non-inductively, might be employed. This question of the employment of alternating currents upon open circuits containing both condensers and self-induction has been very fully investigated from the theoretical side by Mr. T. H. Blakesley, who in his book on "Alternating Currents" (page 47) writes: "The result may be summed up in the following words: When an alternating generator operates upon a circuit which is closed by a condenser without leakage, and which possesses a coefficient of self-induction, then there is a certain period of alternation which may be given to the generator, at which the condenser might be replaced by a junction introducing no additional resistance into the circuit, the coefficient of self-induction being also removed, without disturbing the current." Although the conditions are somewhat modified when we employ a telephone transmitter in which the period of alternation is continually varying, yet it is easy to show that there will be a wide range for the value of the capacity of the condenser in relation to the coefficient of self-induction of the circuit, within which the general effect will be to enable communication to be effected through a larger number of coils such as those used by M. Cros.

Underground Wires in Broadway.

The Western Union Telegraph Company have just completed the work of drawing into their Broadway conduits, three Waring cables carrying fifty-five miles of wire between the Western Union building and Howard street. Two of the three cables were Waring bunched cables of twenty-five wires each, and the third an anti-induction cable of five wires for the Fire and Police departments. The conduit is a 5-inch iron pipe two and a-half feet underground. The cables were drawn in by horses, and the rapidity of the work was noticeable. On Thursday night in two and a half hours—which is the limit of working time on account of the street cars—forty-two hundred feet of cable was drawn in. This is, we believe, the most rapid work we have seen reported.

Steam heating pipes run alongside the conduit in whole length, and in some places only about one inch distant. Assistant-Manager A. S. Brown, of the Western Union Company, who carefully supervised the work said; "We required a cable that, while filling our requirements as to insulation and conductivity for our high tension currents, would also withstand the heat from the steam-heating pipes. After many tests we decided to use the Waring cables."

The Standard Company is also now engaged upon the working of laying underground 200,000 feet for the New York Fire Department under the new contract. This work begins at Avenue A and 68th street, extending through 68th street to the rear of the new fire department headquarters, thence through Lexington avenue and 65th street, and crossing Central Park to 8th avenue and 66th street. These are all six-conductor anti induction cables. The average number of cables along the route being five cables or thirty wires, and the largest number, seventeen cables, or one hundred and two wires. The work is expected to be completed in thirty working days.

Philadelphia Telegraph Service.

ITS NEW QUARTERS IN THE PUBLIC BUILDINGS.

On the 1st of Jan'y next the Electrical Department will occupy its new quarters in the City Hall. The rooms are on the fifth floor, in the east centre pavilion, looking down Market street to the Delaware. The main or operating room is 30 feet high, 52 feet wide and 48 feet long. To the north and south of it respectively are rooms 10 by 41 feet each. On the south is Chief Superintendent Walker's private office; that on the north is for General Manager Ledger and his clerk. All are furnished in light woods, cherry and ash. Thirty bell magnets on the south side of the main room connect with the fire-alarm service. On the northern side are the repeating instruments.

At the west end stands the switch-board, the back of which looks like the interior of the handsomest grand piano. Each circuit has from four to ten engine houses on it. When the policeman sends an alarm from the box on his beat the covers on the switch-board fall from the numbers of all those in that circuit. In this event, if an alarm circuit is not working, the enunciator at the top of the switch-board fails to drop, and thus shows the defect in the circuit. Then the operator makes his tests to discover the cause. There are two automatic repeaters and one manual or three dial repeater, all elaborate pieces of work, as also are the receiving or signal circuits and the transmitting or alarm circuits.

Three tables in the middle of the room have on them the repeating instruments, banks of relays and keys, and in the south-east corner is the telephone switch-board. Diagonally opposite a railed space forms the reporter's office, and in another angle that of the inspector. There are also sleeping accommodations for the operators. Three chandeliers and side brackets provide for brilliant light, and there are appliances to avert dangerous induction from the illuminating wires and the effects of lightning. This is to be done by fusible wires or broad surfaces of metal connected with the ground. The apparatus cost $10,000.

On the floors above are the battery and storage rooms. The complete system of bringing in and thoroughly insulating the wires and batteries is brought to view, showing how no portion of the current is lost, but its full force preserved.

*** Mr. Benjamin Blum, formerly of J. H. Bunnell & Co., with Mr. Benjamin Sturges, late Secretary of the Manhattan Electric Company, have formed a partnership under the firm name of Sturges & Blum, and are now prepared to do all kinds of electrical business, making a specialty of putting in electric bells, burglar alarms, etc.

*** The street cars of Pensacola, Fla., are to be run by electricity.

There are already 30,000 kilometers of telephonic wires on the lines of German railways.

Mr. Warner's Report on the Testimony Taken by the Railway and Telegraphic Subsidy Committee.

Last February the House instructed the Committee on Post Office and Post Roads to ascertain whether additional legislation is needed to prevent a monopoly of telegraph facilities to secure to the Southern, Western and Pacific States the benefits of competition between the telegraph companies, and to protect the people of the United States against unreasonable charges for telegraphic service. The resolution also authorized the committee to take testimony. The resolution was introduced by Mr. Anderson, of Kansas, who stated to the committee that, under the charters of all the land grant railroads, they are required to operate their telegraph lines precisely as they operate their rails; that is without discrimination, and that all the land grant railroads have transferred their telegraph franchises to the Western Union Telegraph Company, the result of which action is that when a rival telegraph company reaches an eastern terminus, these roads, instead of receiving from that company, without discrimination, the business of such company, refuse, or practically fail, to do so. The testimony taken by the committee covers nearly 200 pages. It was referred to Mr. A. J. Warner, of Ohio, for consideration and report to the full committee. He reported to the committee today his conclusions based upon the testimony and the law which are as follows: "From an inspection of the several acts relating to the construction of the several railroads and telegraphs, it will be seen first that in all cases the grants of land and of bonds where bonds were granted, were to aid in the construction of a railroad and telegraph line, the two being inseparably connected in all the grants. The grant was for a telegraph line as well as for a railroad, and the obligation to construct, maintain and operate a telegraph line rests upon precisely the same foundations and conditions, and is as binding as the obligation to construct, maintain and operate a railroad; second, the railroads were required to be operated as continuous lines for all purposes of communication, travel and transportation, as far as the Government and the public are concerned, and in such operation and use to afford and secure to each equal advantages and facilities without discrimination. These provisions apply as explicitly to the construction, maintenance and operation of a telegraph line as to railroads. Nor can a railroad company divest itself of this obligation by contact with another company. It is an obligation the railroad company cannot abandon.

Do the land grant railroads now maintain and operate telegraph lines as they operate their roads, affording equal facilities to the public in general, or do they not? The evidence presented to the committee seems conclusive that they do not; but, on the other hand, that they have entered into contracts with the Western Union Telegraph Company by which said company does most of the business for the roads themselves, and practically the entire commercial business done over the wires stretched along the land grant roads. These contracts are exclusive in their nature, and practically place the entire control of the business between the Atlantic and Pacific States in the hands of one telegraph company. The report was considered by the Committee on Post-Offices and Post Roads to-day, and at another meeting to be held to-morrow it will probably be adopted by a majority of the committee and ordered to be presented to the house, to accompany a bill framed by Mr. Warner, as a remedy for the evils complained of, which will be recommended to be passed. This bill extends the provisions and penalties of the act of June 20, 1874, so as to apply to telegraph lines as well as to railroad lines. It provides that all railroad companies to which the United States has granted any subsidy in lands or bonds or loan credit, for the construction of either railroad or telegraph lines, and all companies engaged in operating said railroads shall forthwith and henceforward, by and through their own respective corporate officers and employes, construct, maintain and operate both for railroad, Government and commercial purposes, telegraph lines, and exercise by themselves alone all the telegraph franchises conferred upon them, and obligations assumed by them under their charters. It also requires them to operate their lines so as to afford equal facilities to all without discrimination in favor of or against any person, company or corporation whatever. If they fail to do so, application for relief may be made to the Commissioner of Railroads, who shall report to the Secretary of the Interior and the Postmaster-General, who shall order what arrangement is proper to be made, and this order may be enforced by the courts. Provision is also made for annulling monopolistic contracts, and for punishing violations of the law. If this bill should become a law, it would place all telegraph companies upon an equal footing.

How Chicago Sends Messages to Everybody and Everywhere.

WIRING THE ANTIPODES—SENDING CIPHER DISPATCHES—OF INTEREST TO THE PUBLIC.

Our Chicago correspondent says that "the general public has no idea of the extent of the cable business in Chicago. Nor have many people an adequate conception of the vigorous manner in which cables and land lines have been spread over the universe. There are now, I believe, eight cables between North America and Europe. They average 3,000 miles long, and in all the world I understand there are something like 100,000 miles of submarine telegraph lines. South America is connected with Europe by a cable from Lisbon, Portugal, to Pernambuco, Brazil, a distance of 3,333 nautical miles. This is the longest cable. Two cables connect Florida with the island of Cuba, and one extends from Cuba to Aspinwall on the Isthmus, and another to Rio Janeiro. From Trinidad, the most southerly island of the West Indies, a cable follows the coast line of Brazil clear down to Montevideo in Uruguay, touching at many ports. There are sixteen cables crossing the North sea and the straits of Dover. Two cables connect England and Portugal, and one cable connects England and Spain. Nearly a score of cables lie beneath the Mediterranean. One extends the entire length of the Red sea, from Suez to Aden, thence under the Arabian sea to Bombay across India, under the Bay of Bengal to Penang and Singapore on the Malay peninsula, thence north under the Gulf of Siam and China sea to Hong Kong and China. This is known as the Indo route in the east, and extends to Yokohama and Yeddo, Japan.

"A cable under the Sea of Japan connects Nagasaki with Vladivostok, one of the most remote points in Siberian Russia. From Singapore a cable touches Java and Sumatra and reaches Australia. Even the Island of Tasmania, lying south of Australia, is connected with the rest of the world by cable, and so is New Zealand. The great African cable, completed some years ago, extends from Aden, Arabia, to Natal, one of the extreme southern ports of Africa. So, you see, the four corners of the earth have been brought pretty close together by the great cables which lie, some of them, nearly four miles beneath the surface of the ocean. The only thing now necessary to complete the electrical circuit of the world is to lay a cable under the Pacific ocean, and I understand that a project is on foot, under the able leadership of Cyrus W. Field, to connect Japan and San Francisco *via* the Sandwich Islands.

"There is not a cable in the world that is not frequently burdened with messages from this city. It is probable that there is not one telegraph office in the world to which we have not transmitted messages, either from residents of Chicago or for persons living in our territory. I sometimes wonder where all the cable messages come from. If an office were to be opened on the coast of Kamschatka, or in lower Patagonia, or up some place near the north pole, it is probable that in less than twenty-four hours some Chicago man would want to send a message there. The cable business of the office is something enormous, and just now it is increasing at the rate of 700 or 800 messages weekly. This is due to the fact that the rates have been so much reduced on messages to England, France, and Germany, it being with these countries, of course, that the bulk of our business is transacted. Cable messages are carried very cheap nowadays—only 15 cents a word to Germany, and only 12 to France and England. See how cheap that is.

"If you are a business man, often using the cables to communicate with other business people, you use a cipher. Besides, your name and address, and the name and address of your correspondent also, are registered at the cable office, so that in the messages one word suffices for the address, and one for the signature. One cipher word may carry your whole message—for instance, the word 'orange' may mean, 'advise you to sell January wheat and buy pork.' For the word in the address you pay 12 cents—addresses and signatures all count in cable work—for the signature 12 cents, and for the cipher word or the message itself 12 cents more. That makes only 36 cents for a message from Chicago to London or Paris. Why, a message to Ashland, Ohio or Anoka, Minn., or Baraboo, Wis., or New Orleans would cost you more money. A very large portion of our cable business is done in cipher."

"Are there any other cable regulations of interest to the public?"

"Yes. Any word containing more than ten letters counts as two words. No punctuation marks are sent, unless requested and paid for. Ch is counted one letter. Cipher words must be in one or all of these languages: English, French, German, Italian, Dutch, Portuguese, Spanish or Latin. Of course, we cannot handle messages in Chinese or Japanese. The Chinese residents of Chicago send many messages to China, but they are all in English. We send all of our cables in English characters, or rather, in their telegraphic symbols. The translations are made, if at all, in the foreign offices. Cipher messages are often a conglomerate of three or four languages.

"In one day you might see many messages to England, France and Germany about corn, wheat, provisions, metal, toys, silks, wines millinery, chemicals, machinery, everything; to Cuba about tobacco and cigars; to the Cape of Good Hope about ivory, barks and diamonds; to Arabia about dates and palm oil; to Java about sugar; to Switzerland about watches; to Siam about furs and hides—to all parts of the world, concerning almost every article known to commerce. Commercial use of cables is developing rapidly because of the reduced rates, and also on account of the growth of Chicago's business interests. The Atlantic cables could not begin to handle the transatlantic business were it not for the fact that some of the wires are worked by the duplex method.

* * Electrical heating stoves are being introduced in France, a peculiar feature of their construction being that the wires are let through apertures formed in plates of refractory clay and plumbago. These plates are not enclosed, but are left exposed, so that the air can circulate very freely through the apertures, where it comes in contact with the red-hot wires. Wire bobbins are inserted in the apertures, each bobbin forming part of the electric circuit, and all being connected for quantity; the bobbins are heated by the passage of the current, and serve to heat the air as it passes to and fro over them.

The resistance in ohms of the human body averages about as follows: From one hand to the other through the body, hands dry, 10,000 ohms. Same with hands wet, 6,000 ohms. The resistance of a Bell telephone coil is about 75 ohms.

TELEGRAPHIC

.... The Canadian Pacific Telegraph has a circuit working direct from New Westminster, B. C., to Canso, N. S., *via* Winnipeg, Montreal, Toronto, Buffalo and New York, a distance of 4,800 miles, and also another direct from New Westminster, C.B., to New Orleans, La., *via* Winnipeg, Montreal, Toronto, Buffalo, Chicago, Indianapolis, St. Louis, Dallas, Tex., and Galveston, Tex., a distance of 5,683 miles. These circuits worked clearly and satisfactorily, thereby showing the superior class of wires owned and operated by the C. P. R. for commercial telegraphy.

.... From a report recently issued the following figures relating to last year's working of the telegraph system in the Argentine Republic: The total number of messages transmitted was 658,000, showing an increase of 15 per cent over the preceding twelve months. The receipts amounted to $271,000, and the expenditure to $515,000, leaving a deficiency of $244 000. During the last five years 4,190 miles of wire have been erected, the total mileage being now over 7,400.

.... The work of laying the Mackay-Bennett cable between San Francisco and the Oakland mole will be done this week by T. P. H. Whitelaw. The cable has arrived from New York, and is now on the Oakland wharf. Its length is 19,500 feet, but of this 15,000 will be first used. It is one and three-quarters inches in diameter, and has in its coils seven electric wires, being the largest sub-marine telegraph cable in America.

.... The Western Union Telegraph boys, in Providence, were talking over the tragic death of poor Nicholas Duff. Contact with the busy world knocks off the square corners of a telegraph boy's character, and renders him more susceptible to the higher emotions than many would think. "We fellows ought to do somethin' for the family," said one. This sentiment met with favor, and the junta in the lane passed to the consideration of ways and means. One way and another were proposed, which seemed to be pulling money right out of a poorly lined pocket, when a lad suggested: "We might all skip the Comique this week." Self-denial proved a winning card, and the boys after estimating what they would have spent in amusement this week, turned in the cash.

.... Judge Barclay, in the Circuit Court at St. Louis, last week, rendered a decision in the suit of District Attorney Bliss against the Baltimore and Ohio Telegraph Company. Mr. Bliss delivered a dispatch to the Baltimore and Ohio Company to be forwarded to a client in Chicago appointing a meeting with him there. The suit was for failure to promptly forward and deliver the dispatch. The counsel for the defense rested upon the stipulations recited in the regulations and conditions printed on the back of the dispatch blanks, including the following: "The company shall not be liable for mistakes or delays in the transmission or delivery, or for the non delivery of any unrepeated message, whether happening by the negligence of its servants or otherwise, beyond the amount received for sending the same." The court says upon that point: "All that need now be stated concerning such a stipulation is that, in so far as it seeks to exempt the telegraph company from the consequences of its own negligence, it is against public policy, and entirely void and of no effect. There will, therefore, be a finding in favor of the plaintiff."

.... It is not necessary to have different metals to obtain a current of electricity. Iron in nitric acid and iron in sulphuric acid, the two fluids being separated by a porous will give a current, one plate wasting away while the other is thickened.

ELECTRICAL AND SCIENTIFIC

* * A new electric motor, invented by Mr. Granville T. Woods, a colored man, of Cincinnati, is being tried in that city for street car purposes.

* * The most powerful engine known is in the zinc mines at Friedensville. It is fed by sixteen boilers, and is of 5000 horse-power.

* * The Capital City Street Railway Company, of Montgomery, Ala., after running the electric motor system over the Court street line uninterruptedly and successfully for six months, have increased their capital stock from $50,000 to $75,000, and have ordered another three miles western extension, adding six cars, all to be run by electricity.

* * The Directors of the Third avenue surface railroad having decided to do away with the use of horses on their line, they are now looking into the matter of electric motors. But the cable idea has not been given up and a choice will be made between the traction system and the electric motors. Edward Lauterbach said recently that there was a movement in favor of the electricity.

* * The certificate of incorporation of the Buffalo Electric Light and Power Company has been filed with the County Clerk for record. The capital stock is $10,000 in 100 shares of $100 each. The trustees are Thos. Hodson, Wilson S. Bissell, Chas. G. Curtiss, Charles W. Goodyear, John M. Brinker, Daniel O'Day and John F. Moulton.

* * Professor S. P. Thompson, in order to test whether electrical conduction in certain mineral ores and metallic oxides is not accompanied by electrolysis, has measured the conductivity of magnetite or magnetic iron ore. The sample selected was a fine homogeneous piece of ore from Arkansas, and was reduced by the lapidary's wheel to a parallelopipedal bar. It was 5.53 centimetres long, 1.52 centimetres wide, and 1.27 centimetres thick. It was placed between electrodes of platinum foil clamped by screws and heated in a bath of paraffine oil up to 135 deg. C. if necessary. A test was made for electrolytic "polarisation," but the result was very small and indicated rather an electro-chemical origin. The resistance was measured and found to diminish very remarkably as the temperature was raised. Thus at 23 deg. C. the resistance of a centimetre cube was 0.719 B. A. units; while at 133 degrees C. it was only .287 units. A somewhat longer and thinner bar of hematite showed a resistance of 108 meg ohms, which, in a preliminary heating, fell to 81 ohms.

* * The question whether the electrical resistance of carbon varies under pressure has been much debated in connection with the Edison telephone patent, and it is interesting to find that Mr. J. C. Mendenhall has made experiments on the matter. His results show that the resistance of soft carbon as reduced by pressure on hard carbon is very small; and this small reduction appears to be largely, if not entirely, due to better surface contact with the electrodes employed in the experiments. Soft carbon, on the other hand, exhibited a greater reduction of resistance, and more or less irregularity in behavior. The resistance is apt to take a permanent "set" if the pressure is excessive. Mr. Mendenhall concludes that when carbon is prepared in the form of compressed lamp-black its electrical resistance varies greatly with the pressure to which it is subjected. A small part of this variation is doubtless to be attributed to change in surface-contact between the carbon and the electrodes through which the current is introduced, but by far the larger part (provided any effort is made to secure good surface-contact) is due to a real change in the resistance of the carbon itself. The resistance of carbon in this condition is fluctuating and uncertain to a degree that seems to prevent its use as a factor in any device or the accurate measure of pressure.

* * Montreal may learn a thing or two from St. Paul. One of the features of the carnival in the far northern city will be the electric illumination of the streets. According to a correspondent eight miles of streets will be radiant with light, clusters of colored gas globes appearing every fifty feet, while at the junction of streets will be gas arches. If the streets are brilliantly lighted it will give an appearance of warmth and comfort to the city that must impress visitors most favorably. The Gas Company should at once begin a vigorous canvass of the city with a view to contracting with as many business men as possible to illuminate the outside of their establishments with gas jets arranged in various novel devices. Those who cannot afford electricity may make use of Chinese lanterns; and in this connection it should be noted that during the reception to Cardinal Taschereau it was impossible to secure a sufficient supply of Chinese lanterns in the city. Those who wish to purchase Chinese lanterns for the Carnival should therefore give their orders to dealers as early as possible. In addition to lighting their own buildings, business men could subscribe to a general fund for the erection of gas illuminated arches, or, better far, for additional electric lights in the city.

* * The London *Electrician* says that English technical publications are often searched in vain for indications of progress in certain branches of applied electricity. So far as this country is concerned, progress seems limited to apparatus connected with electric lighting. We use the term seems advisedly, because we can hardly imagine that improvement is really wanting, but attribute the general ignorance of such improvements to the peculiar position which telegraphy and telephony hold here. That the telegraphic system of England is superior to that of any other country is a fact we readily admit, but we maintain that the public, who really support the system, would like occasionally to be taken more into the confidence of the authorities. They would like to hear of some of the marvellous deeds that are constantly being done, instead of waiting for the next great debate. What, for example constitutes the ordinary number of words transmitted for newspapers in a day throughout the whole country? A cable is laid here or repaired there; but it is only by accident that this work is mentioned in outside official reports. The American and other technical journals from time to time record improvements in telegraphic apparatus, while in England the improvements are made without any such record. The service is benefited all the same whether published or not; but a greater interest is taken in the work, and less soreness felt among inventors and their friends if publicity be given to these improvements.

* * The story of the lost Atlantis may be only a story. Our history is so incomplete, and covers such a brief period, that we have no record of some of nature's mightiest convulsions. Leaving Atlantis out of the question, and accepting the assumption of the scientists that the Creator's work is finished in the Atlantic, the known facts concerning the Pacific are sufficient to convince us that the work of creation is still going on in that quarter. The basin of the Pacific is shaped like a circular bowl, with a well-defined rim, except on the southern side, where it is broken off and the bowl merges into the Atlantic Ocean. The innumerable islands cropping up here and there are supposed to be the peaks of a submerged continent. When this lost continent disappeared is beyond the reach of speculation. Dana's theory was that it had two principal mountain ranges, one running from the Hawaiian group through the Mendona, Society and Pearl Islands, and the other running through the Navigators, Fiji, Solomon, New Guinea, Spice, Celebes, Borneo and Sumatra to Malacca.

Possibly this immense area of land disappeared under the waters in one mighty crash, carrying with it millions upon millions of human beings, with a civilization and arts and industries of which we have not the faintest knowledge. Perhaps the land subsided gradually, forcing people to seek the mountains, until finally the great mass fell victims to flood and famine, and only a few survived.

There is nothing strange in all this. If our globe is gradually cooling it must contract, and the outer shell must crack, break up and sink to fit the sinking interior. Such conditions must result in earthquakes and landslips for ages to come. We know that certain coasts are sinking. Islands appear and disappear. Within the present century a district 2,000 miles square in the Indian Ocean suddenly went down under the water with cities, villages and a large population. The sinking of the Andes 220 feet in seventy years is another significant fact. Altogether we have enough data to shake our confidence in the permanent solidity of this great globe of ours, and we need not be surprised at anything. One thing should reconcile us to these disastrous upheavals. They are all necessary steps in the original plan of creation.

* * At Buffalo last week a surprising test of long distance telegraphing was made. The Postal Telegraph Cable Company, by arrangements made a short time since with the Canadian Pacific Railway Company, has wires through to New Westminster, British Columbia. For several Sundays past the officers of the company have been working a through circuit to Nova Scotia and Newfoundland, where connections were made for London, England, by the Mackay-Bennett ocean cables. Henry Rosener, vice president of the telegraph company has been superintending the arrangements at the western end of the long copper wire. A circuit made by Buffalo failed to work satisfactorily. At 3 o'clock to-day the circuit was made up via Canso, Boston, New York, Albany, and Montreal, and the Canada Pacific to New Westminster. The circuit was 4,600 miles long, and the weather was against wires working well, but five sets of repeaters were used. A message was sent from New Westminster to Canso, cabled to London, and Vice-President Rosener had his answer in exactly 170 seconds, or a trifle less than three minutes. This is said to be the fastest work ever done; and for distance discounts anything ever attempted. The whole distance by wire from New Westminster to London is about 8,300 miles.

THE EXPERIMENT IN LONDON.

NEW YORK HERALD BUREAU, }
LONDON, December 19. }

The Canadian Pacific Railway, working in connection with the Commercial Company, had a test of speed between New Westminster, B. C., and London. Messages were exchanged in one minute. The first message was as follows:—

New Westminster sends greeting to Old Westminster. Weather cloudy, light rain, thermometer, 44. What is the weather with you and time of day? We are working direct from Canso, over a circuit of 4,600 miles.

This was received in London at 8.21. This reply was sent:—

Old Westminster sends kindly greetings to her younger namesake. There is a heavy fog here; temperature, 32. The city is enveloped, but three miles outside it is clear. Time, 8.22.

In the reply to this came the question: "Have you any visitors?" The answer was: "We hoped to have had Sir G. Stephens, but he is prevented from coming here at present."

* * Dr. J. A. Andrews, of New York read a paper recently on the effect of the electric light upon the eye. In considering the relative effect of different forms of illumination, that obtained from gas, from kerosene and from the incandescent light were studied. The electric light gives the maximum of light with the minimum of heat. So far the only cases of injury to the eye from the electric light have resulted from exposure in proximity to the arc light. In most of these cases the existence of previous eye trouble was not excluded. The effect of these cases can be best explained as occurring through the sympathetic nervous system rather than as a result of mechanical or chemical influences. It is not established that exposure to bright light can produce a diffused iritis. No case of injury to the eye from the incandescent light has been reported, and out of 1,100 workers with the electric incandescent light examined by the reader there was not one complaint. Those suffering with errors of refraction claimed that the sight was improved. The light used was from twelve to sixteen candle-power, and provided a shade to protect the eyes. The incandescent light possesses the advantages which are wanting in other forms of artificial light, the principle of which are its steadiness and the fact that its use does not contaminate the atmosphere.

Behavior of Metals and Metallic Compounds in the Electric Currents.

DR. GEORGE H. BENJAMIN.

In a series of experiments conducted for the purpose of determining the metal or composition of metals best adapted for use, as the positive electrode of a storage battery, the following results were obtained:

If an electric current is sent through a cell containing a solution of sulphuric acid in water, and electrodes of silver be immersed therein, a coating of amorphous peroxide of silver will be formed upon the positive electrode. The same deposit will take place if instead of acidulated water, a solution of sodic sulphate be employed. No peroxide will be formed in a solution of nitrate of potassium, but a flocculent light brown precipitate of oxide of silver forms in the liquid. In a solution of potassic ferrocyanide, the silver becomes covered with a white film of argentic ferrocyanide, and in a solution of potassic bichromate with a reddish black film of crystallized argentic chromate. The deposit of peroxide of silver is active in the battery, as are also the other deposits mentioned, but the first named is the only one which has any commercial value; the others are unstable in character and rapidly become inactive. Substituting palladium for the electrodes in the electrolyte of dilute sulphuric acid, the positive electrode is covered with an almost black film of peroxide. With the electrodes of lead in the same solution, a coating of brown peroxide is formed upon the positive electrode. With the electrodes of thallium, a black oxide is deposited. Osmium being freely porous, is converted into osmic acid. With platinum, the deposit is an oxide which is almost immediately acted upon by the solution to form a sulphate. Continuing the experiments with alloys of the different metals, it was found that an alloy of palladium and lead received the most permanent coating in the form of a peroxide. Alloys of lead, antimony and mercury received a coating of peroxide which was firmly coherent for a time, but, upon standing, the mercury separated from the other metals and gravitated to the bottom of the cell. Without giving details, lead was found to be the most readily oxidizable, and lead and palladium the next in the list. The composition best suited for use in the battery, taking into consideration the oxidizability, strength of electrode, and tenacity of deposit, was found to be a mixture of lead, antimony and palladium.

According to an ancient custom of the house a fat turkey was given to every one of the employes of E. S. Greeley & Co., (successors to L. G. Tillotson & Co.) on Christmas morning. This generous gift included everybody, directly or indirectly, employed by the company, and made quite an extensive list sent out by this widely known electrical house.

——The new electric light plant for Bridgeton, N. J., will be put into operation on January 1.

Digest of U. S. Patents on Storage Batteries.

REFERENCES TO FOREIGN PATENTS OBTAINED THEREON.

(TWELFTH PAPER.)

1885.

331,407. Dec. 1, 1885. Filed Dec. 4, 1884
English pat., No. 6,068, April 7, 1884.
French pat., No. 164,602, Oct. 3, 1884.
German pat., No. 32,987, Oct. 5, 1884.
Italian pat., No. 17,485, Nov. 30, 1884.
Austrian pat., No. 37,563, Jan. 23, 1885.
Edward Jones, Leeds, England.

Describes an electrode formed of a number of strips, ribbons or wires, of metallic lead or lead alloy, arranged in rows and integrally united at one end only, with a base or plate of similar material, and preferably at right angle thereto.

Positive and negative electrodes are alike, and separated by strips of glass.

331,408. Dec. 1, 1885. Filed July 31, 1884.
English, French, German, Italian and Austrian, same numbers and dates as Pat. No. 331,407.
Edward Jones, Leeds, England.

Describes a method of casting a solid plate to the end of the strips. A casting mould, chilled over a certain portion of its depth, is employed.

333,292. Dec. 29, 1885. Filed Dec. 26, 1884.
English pat., No. 16,276, Dec. 11, 1884.
French pat., No. 165,965, Dec. 16, 1884.
Belgic pat., No. 67 258, Dec. 17, 1884.
German pat., No. XIX., 18,504, Feb. 1, 1885.
Italian pat., No. XXXIV., 404, June 30, 1885.
Desmond G Fitzgerald, Thomas J. Jones, London, England.

Describes a method of constructing the positive electrodes for storage batteries, and preventing local action between the body of the electrodes and the oxide of lead thereon, which consists in first forming a layer of oxide on the body or plate, then covering this layer with paraffine, finally scraping the surface of the paraffined layer, and pasting with lead oxide in the usual manner. It is claimed that by this process the electrode is prevented from coming in contact with the plate, and thus setting up local action between the plate and the layer of oxide.

334,027. Jan. 12, 1886. Filed May 14, 1884.
Frederick W. Meeker, N. Y. City.

Relates to a tank or cell for batteries, made from a composition of silicate of alumina and silica in about equal proportions, and glazed with fusible silicates.

334,027. Feb. 16, 1886. Filed May 25, 1885.
E. M. Gardner, Brookline, Mass.

Describes a composition from which to mould electrodes, consisting of lead oxide, calcined magnesia and the mother-liquor from salt manufacture.

336,102. Feb. 16, 1886. Filed May 25, 1886.
E. M. Gardner, Brookline, Mass.

The central portion of a sheet of lead is partly cut or divided to form a series of shelves or bars. A paste of lead is applied on and over the troughs or shelves and bar, so as to cover the whole plate on both sides, the ostensible object of this construction being to support the oxide on the plate.

—— At a meeting held last week in the office of W. Preston Hicks, No. 108 South Fourth street, Philadelphia, a temporary organization was formed by a number of prominent gentlemen interested in the Edison Electric Light Company, which has been granted a charter to operate in that city. The wires will all be laid underground, and it is the intention of the company to supply the light at least as low as the price of gas. Among the gentlemen interested in the enterprise are Charles M. Swain, B. K. Jamison, Amos R. Little, Henry M. Dechert and Samuel B. Huey. Officers were elected, but the amount of the capital stock has not yet been decided upon.

A St. Louis Man Suggests a Solution of the Street Wire Problem.

Col. Flad, President of the Board of Public Improvements, suggests a new and somewhat novel solution of the telegraph and telephone wire troubles in cities. Col. Flad's plan calls for iron towers 100 to 135 feet in height at each second street intersection, the towers to consist of four wrought-iron columns, the base of each to be implanted at the corner of the sidewalks, and these columns coming to a common center in the middle of the street to furnish a resting place for all telegraph, telephone and electric light wires. Col. Flad argues that this system would abate the wire nuisance as it at present exists, and much more cheaply than it could be accomplished by placing wires underground. His plan also embraces provision for electric lamps on the towers for street-lighting purposes and provides wires by which to operate street cars on the Siemens principle as employed in Berlin.

An Editor's Use of Electricity.

Electricity is put to a novel use in Russia. One great, if not the greatest, disadvantage the Russian farmers experience is the shortness of the daylight, in consequence of which they cannot get sufficient wheat thrashed. Owing to the severe competition of America and India in respect to wheat, Russian farmers and proprietors have lately sustained very heavy losses, which threaten to increase to an extent which will mean ruin to them. Realizing this grave and very real danger, the editor of the Russian *Selsky Khoziane* has introduced on his farm the electric light, by which the work has been carried on later than was previously possible, and very satisfactory results have ensued.

A BATTERY QUESTION.—A correspondent asks: "Is it possible for me to run different kinds of cells on the same circuit?" Generally it is undesirable. For electric lighting one gravity cell would, on account of its internal resistance, considerably reduce the current, and the whole set of batteries give unsatisfactory results. If small and large cells are connected in series, the smaller become exhausted first and then merely interpose resistance in the circuit. Open circuit batteries may be composed of different varieties of batteries, the great advantage being that the solution or negative plate needs renewal in one variety before another.

Mrs. Geo. N. Stone, wife of General Manager Stone, of the Cincinnati Telephone Company, died December 21, at the family residence on Observatory avenue, Mt. Lookout. Captain Stone will receive the sincere sympathy of all his many friends in this sad bereavement. The Cincinnati *Commercial Gazette* says: "Mrs. Stone caught cold while in attendance upon the American Opera, and this developed into the dread typhoid-pneumonia, and despite every attention that wealth and money could bestow, the blow came with crushing weight upon the husband and family. Mrs. Stone was a native of Gardiner, Me., and became the wife of the Captain about twenty-five years ago. She leaves three daughters, Miss Maud, little Mary, whose age is about seven, and a baby not more than a year and a half old. People who had the good fortune to know the deceased will ever remember her as a lady of unusually fine sensibilities, generous to a fault, of a sweet disposition, kind and obliging to every one. The funeral services will take place to-morrow afternoon."

UNITS OF ILLUMINATING POWER.—The standard "candle" is of spermaceti, seven-eighth inches in diameter (six to the pound), burning 120 grains per hour.

The French carcel is a lamp of specified construction, burning 42 grammes of pure colza oil per hour. One carcel is equal to about 9½ "candles."

The unit adopted by the International Congress at Paris, April, 1884, is a square centimeter of molten platinum at the temperature of solidification. The surface illuminated by it in photometric test is to be normally opposite to the surface of the molten platinum It is equal to 2.08 carcels, or about 19¾ candles. Such a standard is of little practical use on account of the difficulty of maintaining the platinum at such a heat uniformly. A large amount of current also is required. This may, however, be said in its favor, that it is about of the luminous intensity of the lamps to be measured.

Siemens & Halske, of Berlin, have organized a company for promoting and exploiting electric lighting throughout the cities of Holland.

At Marseilles, France, the gas company has succumbed to the pressure, and constructed a central plant to furnish electric lights for the cafés and restaurants.

The directors of the German Theater at Berlin have contracted with Siemens & Halske for an installation of electric lights for that place of amusement. The price paid is 50,000 marks. There were previously in the city of Berlin a total of 152 plants, comprising 736 arc and 12,705 incandescent lamps. Out of the 152 installations, 30 are run by gas engines.

To make a cheap bichromate battery procure a marmalade jar 5 inches deep by 2½ inches diameter at the top, also two plates of carbon (without terminals) each 5 inches by about 2 inches, and a zinc plate of the same size. Amalgamate the zinc thoroughly, and solder a binding-screw at the top. Cut two pieces from a cigar box, 3 inches long and ½-inch broad. Place the two pieces of wood to the right and left of the top of the zinc; place the two carbons to right and left of the pieces of wood, and fix this arrangement by means of a clamp binding-screw, which becomes the carbon terminal. When the cell is in action the plates are in the usual bichromate solution in the jar, supported by the projecting ends of the pieces of wood. When not in use lift the plates out. Retort-carbon would do, if one had the patience to cut it.

—— The Wilkesbarre Electric Light Company have bought out the plant of its rival—the Excelsior—and took immediate possession. The price was $14,500. The Excelsior had a capacity for furnishing 90 arc lights, and had customers for a few over 30. The old company's arc light capacity was only about 120, of which every light was sold. It became necessary for them to enlarge their arc plant, and they were about to purchase the necessary appliances in New York when an opportunity presented itself of making a deal with the Excelsior people. It is said they got the plant for about their own figures, certainly the figures were as low as they could have got in market, to say nothing of getting the opposition company out of the way.

—— It is stated that the only incandescent light central station in Holland, that at Kinderdijk, is most extraordinary in character. It is situated in a small village, where gas was once used, but the pipes rusted away in the damp soil, and the company took up electric lighting as their only alternative. The house for engine, boiler and dynamo is surrounded by water, and the house stands on piles. It was found that the vibration was quite perceptible, and hence a boat load of sand was dumped under the building, which remedied the evil entirely. It is a 400-light Edison plant and is now running in fine order. The service is used by the most humble, whose wages are not higher than five francs a day, and the price charged makes it probably the cheapest electric light in the world. The company are only allowed to pay 5 per cent. per annum, the surplus going toward increase of plant. The capital invested is about $3,000. The price of lighting up to 12 P. M. varies with the number of lamps from $2.57 per annum for one 16-candle lamp, to $2.12 each per annum for 20 lamps. It is somewhat striking that the same trouble with rusting gas pipes is experienced alike in the marshes of Kinderdijk and the lofty table land of the City of Mexico.

ELECTRIC LIGHT NEWS

—— We wish you all a Happy New Year.

—— The People's Gas Light Company at Canton, Ill., has changed its name so as to include electric lighting.

—— The Traders' Electric Light Company, Bridgeport, Me., have adopted the Fuller-Wood system of arc lights. They use two Armington and Sims Company engines for power.

—— The Jarvis Engineering Company, 61 Oliver street, Boston, has received the order to set five steel boilers, with the Jarvis patent boiler setting, for the United State Electric Light Company, Washington, D. C.

—— A new gas company is talked of in Newton in connection with Brookline, to be called the Newton and Brookline Gas Company. All the new and latest improvements will be used, and it is proposed to sell gas for $1.00 to $1.50 per 1,000 feet.

—— From correspondence we learn that the Salt Lake Power, Light and Heating Company will shortly go into the incandescent lighting business and run regardless of midnight bells, provided the dear people desire the light in the young hours of the day, rumors to the contrary notwithstanding.

—— Articles incorporating the Splitdorf Insulated Wire Company have been filed in the County Clerk's office. The object of the company is to manufacture insulated wire and telegraph instruments The capital stock is $10,000, and the incorporators Theodore E. Otis, Henry Splitdorf and Edward E. Knowles.

—— The extensive rubber reclaiming works of Loewenthal & Morganstern, whose New York office is at 132 Nassau street, have just got into operation an incandescent electric lighting plant. The Sawyer-Man system is used—the system of the Consolidated Electric Light Company, and it is working to entire satisfaction.

—— The Boston *Journal* is authority for stating that the Boston Gaslight Company is to petition the Massachusetts Legislature for authority to supply electric light and power to those to whom it now supplies gas. The South Boston Gaslight Company and the Cambridge Gaslight Company also ask for authority to furnish electric lights.

——The Edison system of electric light introduced at Altoona, Pa., so lately has now run successfully and satisfactorily since the first start. It gives general satisfaction to their patrons, and their list of customers are daily increasing. It is creditable to "The Marr Construction Company" that they appear to have done their work so well, with their intricate machinery and system of wires, and that there has been no interruption in the constancy or steadiness of their light.

—— The Consolidated Electric Light Company of Portland, Maine, a majority of which is owned by the American Electric Manufacturing Company, is making very large additions to its present plant. The company now lights the entire city of Portland. Three hundred arc lights are now in use, and about 400 Edison incandescent municipal lamps. The company's present building having become inadequate to the demands for increased light, a new building, 60x100 feet, is being built, and will be completed within sixty days. It will be one of the finest blocks in Portland. New boilers and engines are now being installed. The arc and incandescent systems are both to be largely increased. Besides the lighting, the company are going to put in a large installation of electrical motors for the transmission of power. It is said about 500 horse-power will be installed this winter.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING DEC. 21, 1886.

354,530 Electric lamp; Hermann R. Boissier, New York, N. Y.

354,538 Dynamo-electric machine or motor; Chas. G. Curtis and Francis B. Crocker, New York, N. Y., assignor to the C. & C. Electric Motor Company.

354,539 Dynamo-electric machine and electric motor; Charles G. Curtis and Schuyler S. Wheeler, New York, N. Y., assignors to the C. & C. Electric Motor Company.

354,541 Telephone transmitter; Daniel Drawbaugh, Eberly's Mills, Pa., assignor to the People's Telephone Company, of New York.

354,542 Telephone transmitter; Daniel Drawbaugh, Eberly's Mills, Pa.

354,588 Dynamo-electric machine and electric motor; Schuyler S. Wheeler and Charles G. Curtis, New York, N. Y., assignor to the C. & C. Electric Motor Company.

354,606 Electrical distributor; Richard H. Mather, Windsor, Ct.

354,637 Electro-magnetic boiler-cleaner; Gerald W. Hart, Quincy, Ill.

354,639 Electric lamp; Charles D. Jenney, Indianapolis, Ind.

354,758 Mast or tower; John S. Adams, Indianapolis, Ind., assignor to the Jenney Electric Company, same place.

354,759 Mast arm; John S. Adams, Indianapolis, Ind., assignor to the Jenney Electric Company, same place.

354,760 Reflector; John S. Adams, Indianapolis, Ind., assignor to the Jenney Electric Company, same place.

354,761 Non-interfering street box for fire alarm telegraph systems; Alexander Anderson, Toronto, Ontario, Canada.

354,781 Electric lighting; James E. H. Gordon, 28 Collingham place, Kensington, county of Middlesex, England.

354,782 Means for lighting railway and other signal lanterns by electricity; James E. H. Gordon, 28 Collingham place, Kensington, county of Middlesex, England.

354,783 System of electric lighting; James E. H. Gordon, 28 Collingham place, Kensington, county of Middlesex, England.

354,788 Incandescent lamp; Arthur S. Hickley, Groton, Conn., assignor to the Jenney Electric Company, Indianapolis, Ind.

354,791 Regulator for dynamo-electric machines; John H. Irwin, Morton, Pa.

354,793 Electric motor for railways; Walter H. Knight, Cleveland, Ohio.

354,814 Telegraph instrument; Josef Steiner, Brooklyn, assignor to Haskins & Steiner, New York, N. Y.

354,815 Telegraph instrument; Josef Steiner, Brooklyn, assignor to Haskins & Steiner, New York, N. Y.

354,827 Railroad signal; George D. Burton, New Ipswich, N. H.

354,838 Electrical pumping apparatus; Moses A. Michales, Allegheny, and Albert Michaels, Pittsburgh, Pa.

354,847 Cut-out for electric arc lamps; Willie C. Walter, West Point, assignor of one-half to George B. McAdams and Rowland Hill, both of Richmond, Va.

354,856 Annunciator and alarm signal; Joseph W. Frost, Rochester, N. Y.

354,858 Electric circuit closer; John Geary, Philadelphia, Pa., assignor of one-half to J. Elliot Shaw, same place.

REISSUES.

10,791 Electric fire alarm or thermostat; Charles E. Kells, Jr., New Orleans, La., assignor, by mesne assignments, to the National Automatic Fire Alarm Company, of New York.

BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court 17 Beekman St., New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chem st in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World*'s Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend."
—*New York Observer.*

Baker & Co., gold, silver and platinum refiners, assayers and smelters, 408, 410, 412 and 414 N. J. R. R. ave., Newark, N. J. Platinum for all purposes, any degree of hardness or size. Wholesale or retail. Native or scrap platinum, melted, refined or purchased.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel. WASHINGTON, D. C.

CARBONS
FOR ARC LIGHTING.
Only Manufacturers using Natural Gas, thus securing
Uniformity, Durability & Superior Light.
PITTSBURGH CARBON CO. lim'd,
PITTSBURGH, PA.

UNITED ELECTRIC COMPANY,
SALT LAKE CITY, UTAH, AND CHEYENNE, WYO.,
Dealers in Electrical Apparatus and Supplies.
We have special facilities for furnishing material and doing work in Utah, Wyoming, Idaho, Montana and Washington Territories at Eastern prices.
UNITED ELECTRIC COMPANY,
Post Office Box 277, SALT LAKE CITY, UTAH. | Post Office Box 574, CHEYENNE, WYOMING

KANSAS ELECTRIC CO.
185 Kansas Ave., Topeka, Kansas.
DEALERS IN
Hotel Annunciators, Burglar Alarms, Fire Alarms, Telegraph Poles, Electric Bells, Electric Gas Lighting and Electric Alarm Matting.
ESTIMATES GIVEN ON ELECTRIC LIGHT PLANTS, Fire Alarm Systems and Private Telephone Lines.

Detroit Electrical Works
MANUFACTURERS OF
ELECTRIC SUPPLIES,
INCLUDING
Medical Batteries, Skeleton and Box Bells, Burglar Alarms, House Annunciators, Fire Alarm Boxes, Pins, and Brackets,
INSULATED MAGNET, TELEPHONE AND ELECTRIC LIGHT WIRE.
GENERAL OFFICES and FACTORY:
DETROIT, MICHIGAN.

South Western Electrical Supply Company,
1304 ST. LOUIS AVE., "STATION A.,"
KANSAS CITY, MISSOURI,
DEALERS IN
ELECTRIC LIGHT LINE CONSTRUCTION, MATERIAL AND TOOLS. GLOBES, CARBONS AND OIL A SPECIALTY.

SHAW: & : GEARY
MANUFACTURERS OF
ELECTRICAL APPLIANCES
Special Tools and Dies. Model and Experimental Work a specialty.
Nos. 53 and 55 North Seventh Street, Philadelphia.

Fig.259

PHOENIX GLASS COMPANY,
(Works, Water Cure, Beaver County, Penn.)

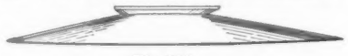



Fig.255
——MANUFACTURERS OF——
A FULL LINE OF ELECTRIC LIGHT GLOBES & SHADES, BOTH ARC AND INCANDESCENT,
In Opal, Flint and Art Glass Effects, in Opalescent and other Colors.

A. H. PATTERSON, Manager. 729 BROADWAY, COR. WAVERLEY PLACE, NEW YORK.

THE ONLY GENUINE
LECLANCHÉ DISQUE BATTERY
IS THAT MADE BY
THE LECLANCHÉ BATTERY COMPANY.
Every Jar and Porous Cell bears the label and trade mark as shown in the cut.
All others are imitations.
DO NOT BE IMPOSED UPON.
IF DEALERS HAVE NOT THE GENUINE BATTERY. SEND DIRECT TO US FOR PRICE LIST.
None of the Imitations Compare with it in Efficiency.
THE LECLANCHÉ BATTERY CO.
149 W. 18th St., New York.

GENUINE DISQUE CELL, COMPLETE. The Porous Cell also bears Label.

GENUINE DISQUE POROUS CELL.

Standard ✣ Electrical ✣ Works,
MANUFACTURERS OF
TELEGRAPH AND TELEPHONE APPARATUS,
Hotel and House Annunciators, Burglar Alarms,
CALL BELLS, "POST'S" MAGNETO BELLS,
PINS and BRACKETS, BATTERIES, &c., &c.
IN STOCK:—FULL LINE
IRON, STEEL and HARD-DRAWN COPPER WIRE, Delivered at Lowest Prices.
☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜
Cincinnati, Ohio. U. S. A.

ELECTRICAL TEST INSTRUMENTS.

MADE BY THE ELECTRIC MFG. CO. OF TROY, N. Y.

GOODS FROM STOCK IN NEW YORK.

VITRITE AND LUMINOID COMPANY, Agents, 14 DEY ST., N. Y.

SAWYER-MAN ELECTRIC CO.

Licensed by and Succeeding to the Commercial Business of the

Consolidated Electric Light Company,

—OWNERS OF THE SAWYER-MAN PATENTS.—

GENERAL OFFICES:

Mutual Life Building,

No. 32 NASSAU ST.,

N. Y. City.

PHILADELPHIA OFFICE,

No. 205 Walnut Place.

BOSTON OFFICE,

No. 33 FEDERAL ST.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will Maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

ESTIMATES FURNISHED FOR THE THOMSON-HOUSTON SYSTEM OF ARC LIGHTING.

THE UNION FIRE ALARM CO.

145 Broadway, New York,

ARE NOW PREPARED to FURNISH the CHEAPEST & BEST COMPLETE

Fire Alarm System

EVER DEVISED.

PARTICULARLY ADAPTED to SMALL CITIES and TOWNS.

—Correspondence solicited and Estimates furnished.—

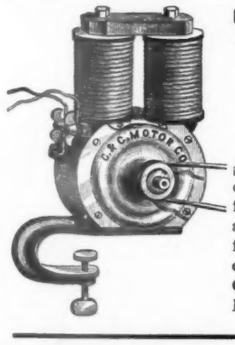
THE

American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.



The C. & C. Electric Motor Co.

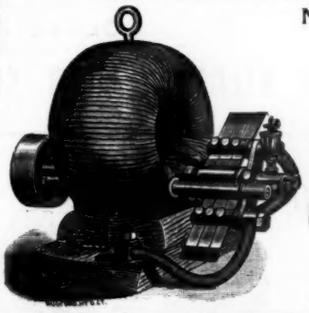
2 WALL STREET, NEW YORK CITY.

This Company is now prepared to furnish Motors of ⅛ horse power and upwards, of Unrivaled Efficiency, convenient in form, neat in appearance, cheap and durable, for Sewing Machines, Jewelers' Lathes, Dental Engines and other small power. Our Battery the most efficient; furnishes ample power for motor or six candle lamp or cautery, etc. Also Special Motors for use on Lighting Circuits for larger power, and *vice versa*, with Steam Power for Electric Lighting in small quantity.

The Mather Dynamo-Electric Machine,

—FOR—

ELECTRO-PLATING, ELECTROTYPING, COPPER REFINING, ETC.



NO REVERSING,
NO WATER,
NO NOISE,
NO SPARK.

SATISFACTION GUARANTEED.

Manufactured by

The Eddy Electric Mfg. Co.

42 UNION PLACE, Opposite the Station,

HARTFORD, CONN.

☞SEND FOR CIRCULAR.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWYER, SEC'Y & ELECTRICIAN.

American Electrical Works,

PROVIDENCE, R. I.

EXCLUSIVE MANUFACTURERS OF THE

FARADAY CABLE

FOR TELEGRAPH, TELEPHONE & ELECTRIC LIGHT.

HIGHEST INSULATION AND LOWEST INDUCTIVE CAPACITY OF ANY CABLE IN THE MARKET.

NEW YORK OFFICE
15 Cortlandt Street

HARRY HALL, Agent.

THE

India-Rubber & Gutta-Percha Insulating Co.

MANUFACTURERS OF

ALL KINDS OF INSULATED WIRES AND CABLES.

Guaranteed to give satisfactory services under ground and over head. Specially adapted for Chemical Works, Paper Mills, Dye Works, Coal Mines, etc., etc.

PRICES AND SAMPLES ON APPLICATION AT

No. 159 Front Street, New York City.

RECEIVER'S SALE

—OF—

Electrical Goods

By order of Frederick Allen, Esq., Receiver of the UNION ELECTRIC MANUFACTURING CO., a valuable assortment of Electrical Goods, including Switch-Boards, Condensers, Relays, Sounders, Telegraph Keys, Rheostats, Relay and Sounder parts, (including Rubber-Covered Magnets and Shells,) Annunciators, Bells, Call Boxes, etc., etc.

Will be sold by JAMES P. SILO, Auctioneer, at his auction rooms, No. 57 Cedar Street, on Friday, December 10th, 1886, at 2:00 P. M.

May be seen at office of Electric Construction and Supply Company, No. 145 Broadway, up to Thursday, December 9th.

The above Sale is adjourned to Monday, Dec. 29, at same time and place.

TELEPHONE STOCKS

Of all the different Companies

BOUGHT AND SOLD ON COMMISSION,

ALSO

Chicago Local Stock and Bonds.

S. G. LYNCH,

146 La Salle Street, Chicago.

ALBERT L. RUSSELL,

Manufacturer of and Dealer in

TELEGRAPH & ELECTRICAL INSTRUMENTS

House and Hotel Annunciators, Line and Office Wire, Fine Instruments for Electric Testing, etc., at the old stand of

CHARLES WILLIAMS, JR.,

109 & 115 COURT ST., BOSTON, MASS.

PROTECTION FOR WATCHES.—The Anti-Magnetic Shield is an absolute protection from all Electric and Magnetic Influence. Can be applied to any watch. Full Experimental Exhibition and Examination, also full assortment of the watches complete at

F. S. GILES, Agent, or GILES, BRO. & CO., Chicago, Ill. **ANTI-MAGNETIC SHIELD & WATCH CASE CO.**, 18 John St., New York.

W. Co. Masters, President W. H. Lawrence, Manager

THE NATIONAL CARBON CO.

CLEVELAND, OHIO.

MAKERS OF ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

—THE—

SOLAR CARBON & MFG. CO.

(Works near Pittsburgh, Pa.)

Electric Light men know the trouble arising from impurities in Carbons. This Company obtains its supply of Carbon from NATURAL GAS, and such gas is used throughout the process. Hence they claim to sell a CHEMICALLY PURE Carbon, unequaled in brilliancy and life.

Selling Agents:

VITRITE & LUMINOID CO., 14 Dey St. New York.

S. B. RICHARDS, M'g'r, General Eastern Office, 55 S. 3d St., Philadelphia.

A PERFECT ELECTRIC LIGHT GLOBE.

THE UNION GLASS COMPANY,

HALF GROUND (Horizontally).

4x10 inches

BOSTON, MASS., U. S. A.,

MANUFACTURERS OF EVERY DESCRIPTION OF

ARC AND INCANDESCENT

ELECTRIC-LIGHT GLOBES

SEND FOR PRICE-LIST.

THE

LITTLE--McDONALD CUT--OUT.

PATENTED MAY 20, 1886. 1,000 IN USE.

SEND FOR CIRCULARS AND PRICES

J. A. POWERS,

TROY, NEW YORK.

THE ELECTRICAL SUPPLY CO.

Manufacturers of and Dealers in

ELECTRICAL INSTRUMENTS and SUPPLIES.

Being Manufacturers of Bare and Insulated Wires and Cables of every description, we are prepared to give prices for large quantities.

We Manufacture the Celebrated Wallace Diamond Carbons for Electric Lights, which are Superior to all others.

OUR NEW ILLUSTRATED CATALOGUE WILL BE MAILED TO ANY ADDRESS FREE OF CHARGE.

THE ELECTRICAL SUPPLY CO.

171 Randolph Street, Chicago, and 17 Dey Street, New York.

FOREST CITY ELECTRIC WORKS,

Handle Removable.

SOLE MANUFACTURERS OF

CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES,

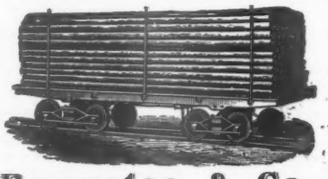
AND OTHER ELECTRIC LIGHT SUPPLIES,

In stock and to order. Contracts made for special manufacture and for the exclusive use or sale of any Electrical apparatus. (Electric Light a specialty). Descriptions and prices on request.

Correspondence Solicited.

W. B. CLEVELAND, Prop.

26 S. WATER ST., CLEVELAND, O



Brownlee & Co.,

DETROIT, MICH.

DEALERS IN

Cedar Telegraph Poles

MANUFACTURERS OF

Cross Arms, Pins and Brackets,

OAK AND LOCUST PINS,

BROWNLEE'S CONCAVED BRACKET.

Patent applied for.) Send for Catalogue

ALFRED F. MOORE,

Manufacturer of

Insulated Wire,

for Telephone, Telegraph and Electric Light.

OFFICE, LINE, AND

Annunciator Wire,

Magnet Wire, and Flexible Cordage,

200 & 202 N. THIRD ST.

PHILADELPHIA, PA.

CARBONS

BOULTON CARBON CO.

FORMERLY

Boulton Standard Carbon Comp'y,

CLEVELAND, OHIO.

We do not brag about our Carbons, but we challenge the World to produce a better.

D. W. Baker. C. O. Baker, Jr.

BAKER & CO.,

Importers, Melters and Refiners of

PLATINUM,

408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.

Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased.

JOHNSON HEAT-REGULATING APPARATUS.

Can be attached to any kind of heating apparatus ever made, and by its use the heating of buildings to a uniform temperature is accomplished. Rooms may be kept at any temperature desired, thereby saving fuel, discomfort, ill health, the cracking of wood-work, furniture and pictures, and the danger of fire by over heating. This apparatus applies equally well to all forms of heating and ventilating devices, the thermometer in the room automatically governing the temperature. It is invaluable in Public Buildings, Private Residences, Business offices, Hospitals, Churches, Schools, Conservatories, Factories, etc.

SEND FOR CIRCULAR "R."

NATIONAL ELECTRIC SERVICE CO.

NEW YORK, 686 Broadway. CHICAGO, 195 Wabash Avenue. BOSTON, 611 Washington Street.

Poole & Hunt's Leffel Turbine Water Wheel.

Made of Best Materials and in the Best Style of Workmanship.

MACHINE-MOLDED MILL GEARING,

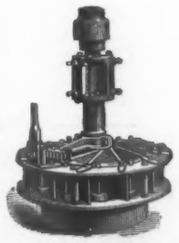
From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.

SHAFTING, PULLEYS AND HANGERS

Of the latest and most improved designs.

Transmission Machinery

A SPECIALTY.



☞ Special attention given to Heavy Gearing. Shipping facilities the best in all directions.

POOLE & HUNT, Baltimore, Md.

THE WESTINGHOUSE MACHINE CO.

SALES LIST FOR NOVEMBER. 1886.

			H. P.
South Side E. L. Co.,		Pittsburgh, Pa.	150
" "	2d order,	" "	150
Union Switch & Signal Co.,	6th order,	" "	75
East End E. L. Co.,	2d order,	" "	75
" "	3d order,	" "	75
Brush Electric Light Co.,	2d order,	Buffalo, N. Y.	60
McConway & Torley,	2d order,	Pittsburgh, Pa.	60
Winona Paper Co.,	4th order,	Holyoke, Mass.	60
New York & Manhattan R. R. Co.,		New York.	60
Mather Electric Co.,		Hartford, Ct.	60
" "	2d order,	" "	60
Jefferson City E. L. Co.,		Jefferson City, Mo.	60
Wahoo E. L. Co.,		Wahoo, Neb.	60
J. C. Livingston & Co.,		Little Falls, N. Y.	45
Weidman Silk Dyeing Co.,		Paterson, N. J.	45
Miller, Broudy & Co.,		Alexandria, La.	45
E. L. McLain Mfg. Co.,	2d order,	Greenfield, O.	45
Van Deventer & Horne,		Plainfield, N. J.,	35
"The Public Ledger,"	2d order,	Philadelphia, Pa.	35
" "	3d order,	" "	35
" "	4th order,	" "	35
" "	5th order,	" "	35
E. Balbach & Son,	14th order,	" "	35
Wolff & Hamaker,		Chambersburg, Pa.	35
Imperial Guano Co.,		Norfolk, Va.	35
Chandler & Price,		Cleveland, O.	35
Wabash, St. L. & Pacific R. R.	2d order,	Ft. Wayne, Ind.	35
Barnes Bros.,		Maquoketa, Ia.	35
A. J. Mullen,		Selma, Ala.	35

			H. P.
Brainard & Shephard,		Albany, N. Y.	25
Henry Warden,		Philadelphia, Pa.	25
Crown Mills,		Marcellus, N. Y.	25
S. R. Cain,		Bristol, Vt.	25
Wabash, St. L. & Pacific R. R.	3d order,	Ft. Wayne, Ind.	25
Minneapolis Gas Light Co.,		Minneapolis, Minn.	25
" "	2d order,	" "	25
Thos. Henshall,		Paterson, N. J.	15
E. Balbach & Son,	15th order,	Newark, N. J.	15
Gas Engine and Power Co.,		New York.	15
Rouilleaux, Dugrae & Co.,	2d order,	Suresnes, Fr.	15
Shickle, Harrison & Howard,	2d order,	St. Louis, Mo.	15
McCord, Ford & Co.,		Colfax, W. T.	15
Decatur Furnace Co.,		Decatur, Ala.	15
Lawrence Machine Shop,	15th order,	Lawrence, Mass.	10
" "	16th order,	" "	10
N. W. Wait, Son & Co.,		Sandy Hill, N. Y.	10
F. S. Cole,		Grundy City, Ia.	10
Union Pacific R. R.,	2d order,	Omaha, Neb.	10
Geo. C. Howard,		Philadelphia, Pa.	5
Merritt W. Burwell,		New Haven, Ct.	5
Westinghouse Electric Co.,	3d order,	Pittsburgh, Pa.	5
Lawrence Machine Shop,	17th order,	Lawrence, Mass.	5
" "	18th order,	" "	5
J. A. Diamond,		Indianapolis, Ind.	5
F. J. Yandle,		Santa Rosa, Cal.	5
Aberdeen Packing Co.,		Astoria, Or.	5
TOTAL, 56 ENGINES,			1975

Sales Department for the U. S. Conducted by

WESTINGHOUSE, CHURCH, KERR & CO., 17 Cortlandt St., N. Y.; 98 Fourth Ave., Pittsburgh, Pa.
FAIRBANKS, MORSE & CO., Chicago, Ill.
FAIRBANKS & CO., St. Louis, Mo.
PARKE & LACY, San Francisco, Cal.
PARKE, LACY & CO., Salt Lake, Utah.
D. A. TOMPKINS & CO., Charlotte, N. C.
ROBERT MIDDLETON, Mobile, Ala.
H. DUDLEY COLEMAN, New Orleans, La.
KEATING IMPLEMENT & MACHINE CO., Dallas, Texas.

WESTINGHOUSE, CHURCH, KERR & CO.

17 CORTLANDT ST., NEW YORK. 98 FOURTH AVENUE, PITTSBURGH, PA.

Engineers and Contractors for Central Stations for Incandescent Lighting on the

WESTINGHOUSE ELECTRIC COMPANY'S SYSTEM.

Isolated Incandescent Plants. Steam Power Plants for Manufacturers.
Direct-connected Centrifugal Pumping Machinery. Designers of Special Applications of Steam Power.

THE WESTINGHOUSE ELECTRIC COMPANY,

MANUFACTURERS OF ISOLATED INCANDESCENT PLANTS, AND CONTRACTORS FOR CENTRAL STATIONS.

It is believed that the advantages of our system place us beyond competition.
Capital investing for dividends will do well to close no contracts till our proposals are considered.

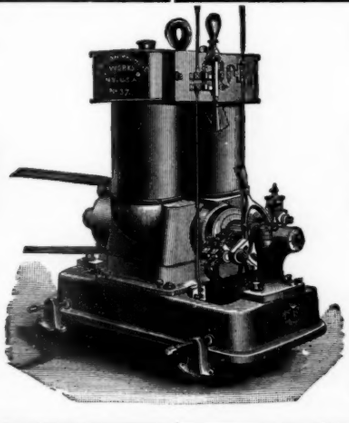
The Westinghouse Electric Company, - - - Pittsburgh, Pa.

16 C. P. LAMP, (half-size.)

EDISON LIGHT.

The Edison United Mfg. Company,

65 FIFTH AVE., NEW YORK.



EDISON LIGHT.

Estimates Furnished For Isolated Plants,

For use in Mills, Hotels, Theatres, Steamboats, etc.

LEATHEROID,

The best Substitute for Hard Rubber for all Electric, Insulating and Mechanical Purposes, costing less than any other insulating material of its class. Furnished in Sheets and Tubes of various thicknesses.

EXPERIMENTAL WORK CAREFULLY AND PROMPTLY DONE.

THE LEATHEROID NOVELTY COMPANY, 74 Bedford Street, Boston, Mass.

Send for Samples and Prices.

MAGNETO SIGNAL BELLS.

"STANDARD."

No Battery Required.

$4, $6, and upwards, according to style desired. Discount on large lots.

We make a specialty of the manufacture of these bells for Telephone Companies, and after an experience of many years, our facilities for the prompt execution of large orders are unequaled.

Close attention given to furnishing samples for special orders.

VIADUCT MANUFACTURING CO.
OF BALTIMORE.

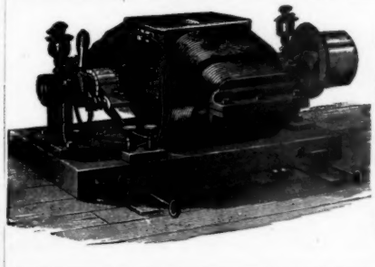
A. G. DAVIS, President. A. B. PROAL, Secy. & Treas.
Office, North-West Corner Charles and German Streets,

ELECTRICAL GOODS OF EVERY DESCRIPTION.

Telephone, Telegraph, Electric Light, Fire Alarm and District Telegraph Supplies.

SEND FOR ILLUSTRATED CATALOGUE.

HECLA ELECTRIC LIGHT COMPANY,



MANUFACTURERS OF THE

Jackson Dynamo-Electric Machines, Lamps, Etc.

For Arc and Incandescent Lighting.

Size A, capacity 20 16 c. p. lamps Price, $160
Size B, capacity 30 16 c. p. lamps. Price, $260
Size C, capacity 50 16 c. p. lamps. Price, $340

—ALSO—

ELECTRICAL SUPPLIES OF ALL KINDS ALWAYS IN STOCK.

Estimates for complete Electric Light and Steam Plants made on application. Send for Circular, and mention this paper.

OFFICE:

26½ E. 42d St., New York.

STANDARD ELECTRICAL INSTRUMENTS.

Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.

ELECTRIC MFG. CO., P. O. Box 80, Troy, N. Y.

BOWSHER'S TELL SPEED INDICATOR.

Especially adapted to Electric Light Machinery. Is absolutely reliable. Connects to machinery with small belt. Besides **continually** showing speed on dial, it **alarms** when speed runs "too fast" or "too slow." Dial, 12 inches diameter. Weight, 10 lbs. All orders must give the exact size and average speed of shaft to be connected with.

N. P. BOWSHER,
Sole Man'r, South Bend, Ind.

STORAGE BATTERIES

AND

IMPENDING LITIGATION.

On May 17, 1882, the public were cautioned against making investments in any scheme or venture based upon the claims of one Camille Alphonse Faure, relating to secondary or storage batteries or accumulators, and notice was then given that the Brush Electric Company of Cleveland were the rightful owners in this country of the inventions laid claim to by Faure and others, and were enforcing their rights by proceedings before the proper tribunals of this government. Those proceedings have been pushed with diligence by the Brush people, and have been opposed and delayed in every possible way by the Faure interests and others, for a period of four years. Decisions, however, have at last been rendered in favor of the Brush interest, and patents have been granted to it covering the entire ground claimed by the Faure people, and the Faure patent is thus rendered valueless; twenty-seven patents, covering the field above referred to, and of cognate scope, have been granted to the Brush Electric Company, and one or more of them cover all the commercial batteries that have been up to now devised. The two principal and foundation patents, which control the use of the so-called Faure storage battery, as well as the Sellon-Volckmar battery and others in the country, and supersede the patent issued to Faure January 3, 1882, numbered 252,002, are dated and numbered respectively, March 2, 1886, No. 337,298, and March 2, 1886, No. 337,299. The public are again advised, as they were in 1883, of the rights of the Brush Electric Company, and that these rights will be enforced.

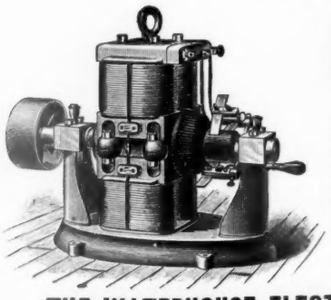
Particulars may be learned of the undersigned, or of William C. Witter, Esq., or William H. Kenyon, Esq., their counsel, 32 Park Place, New York.

BRUSH ELECTRIC COMPANY,
CLEVELAND, OHIO.

THE WATERHOUSE SYSTEM

—OF—

ARC LIGHTING



Is ECONOMICAL in Power Required. The Regulation is AUTOMATIC and INSTANTANEOUS, admitting of the turning off of lights and of running the Generator in Complete Short Circuit, without heat or injury to the Machine. The DYNAMO runs PRACTICALLY NOISELESS and WITHOUT SPARKS ON COMMUTATOR, and those who have seen the System are ENTHUSIASTIC IN ITS PRAISE.

THE WATERHOUSE ELECTRIC AND MFG. COMPANY,
Factory, Colt's West Armory. HARTFORD, CONN.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS.
ESTABLISHED 1867.

PARTRICK & CARTER,

Manufacturers of and Dealers in every description of

ELECTRICAL SUPPLIES for the TELEGRAPH, TELEPHONE, ELECTRIC LIGHT, ETC.

Sole proprietors of the Patent Needle Annunciator. Annunciators, Burglar Alarms, Electric Bells, Batteries, Wire, etc. Illustrated catalogues and price lists sent free.

No. 114 SOUTH SECOND STREET, - - PHILADELPHIA, PA.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use Over 1,000

25 to 1,000 H. P.

These Engines are the combined result of long experience with automatic cut-off regulation and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-Contained Automatic Cut-off Engines, 12 to 100 H.P. for driving Dynamo Machines a SPECIALTY.—Illustrated Circulars with various data as to practical Steam Engine Construction and performance, free by mail. Address

BUCKEYE ENGINE CO., Salem, O.

SALES AGENTS:

W. L. SIMPSON, Eastern Sales Agent, No. 70 Astor House, New York.
ROBINSON & CAREY, St. Paul, Minn. N. W. ROBINSON, cor. Clinton and Jackson Sts., Chicago, Ill. and PRAY MANUFACTURING CO., Minneapolis, Minn.

J. H. BUNNELL & CO.,

106 and 108 Liberty St., NEW YORK.

TELEGRAPH INSTRUMENTS,

Wire, Insulators, Batteries, Bells and Electrical Supplies.

The Largest Stock and Best Variety of Main Line and Short Line Instruments in any American Establishment.

SEND FOR LATEST ILLUSTRATED CATALOGUE, FREE, ALSO TELEGRAPHIC MANUAL, FREE. TO ANY ADDRESS.

Schuyler Electric Light Co.,

Manufacturers of

DYNAMO MACHINES FOR INCANDESCENT AND ARC.

The most perfect system of both Incandescent and Arc Lighting. Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.

Dynamo Machines with perfect automatic regulation, reliable and efficient.

Prices moderate. Estimates made for lighting from Central Stations or for isolated plants. Illustrated Circulars sent upon application. Address

New York Office: No. 44 BROADWAY. **SCHUYLER ELECTRIC LIGHT CO.**, Hartford, Conn.

MITCHELL, VANCE & CO.,

GAS FIXTURE MANUFACTURERS,

Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application

836 & 838 BROADWAY, NEW YORK

PHOSPHOR-BRONZE

TELEPHONE WIRE, Insulated and Bare.

"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS:

The Phosphor-Bronze Smelting Co. (Limited,)
512 ARCH ST., PHILADELPHIA, PA.

Owners - of - the - United - States - Phosphor-Bronze - Patents
Sole Manufacturers of Phosphor-Bronze in the United States

Connecticut Electric Co.

101 BANK STREET,

WATERBURY, CONN.

Zincs, Leclanche Zincs,

with Thumb Screw or Patent Spring Connections, and well amalgamated

GRAVITY BATTERY ZINCS,
MEDICAL BATTERY ZINCS,
BUNSEN BATTERY ZINCS,
ZINC PLATES,

MADE FROM PURE SPELTER.

WOOD AND BRONZE PUSH BUTTONS,
BURGLAR ALARM SPRINGS.

A. T. SMITH'S

(Successor to **Smith, Bridge & Co.**)
NEW PAT'D. ELECTRIC LAVA GAS TIP,
The Cheapest Burner in the Mark.
For Multiple Lighting.
Send for prices to
A. T. SMITH,
6 West 14th St., New York

THE CURT BATTERY.

Actually the cleanest, most durable and practical, therefore the cost economical and effective cell in the market. For experimenting, for medical purposes, for the laboratory, no more suitable cell could be found.

ADDRESS FOR CIRCULARS.

CURT W. MEYER, 357 Fourth Ave. New York.

OUR NEW

LECLANCHE FARADIC MEDICAL BATTERY

Our Leclanche Faradic Medical Battery is of a new and entirely original design.

It is a new departure, and avoids the use of all obnoxious acids that destroy the clothes, stain the hands and make the constant handling of such medical batteries absolutely dangerous.

It is simplicity itself, and in ordinary use will run ONE YEAR WITHOUT ANY ATTENTION, OR THE EXPENDITURE OF A SINGLE PENNY FOR SUPPLIES.

There is no zinc to raise or lower, no fluids to be renewed. It is always ready, and does not corrode when not in use. Its first cost and the subsequent expense is far less than that of the dangerous red or white acid batteries heretofore manufactured.

The LECLANCHE FARADIC has three currents, is nickel-plated and mounted in an ornamentally covered case, 8¼x6¾x5¼ inches in size, and sold at the low price of **$8.50.**

E. S. GREELEY & CO.

(Successors to L. C. TILLOTSON & CO.,)

Manufacturers, Importers and Dealers in

TELEGRAPH, TELEPHONE AND ELECTRICAL INSTRUMENTS and MATERIAL OF EVERY DESCRIPTION,

Nos. 5 and 7 DEY STREET - - NEW YORK.

A GREAT COMBINATION OF GAS AND ELECTRIC LIGHT INTERESTS.

THE AMERICAN SYSTEM THE PIONEER OF THE NEW DEPARTURE.

ELECTRIC LIGHTING AS DEMONSTRATED BY THE

AMERICAN ELECTRIC MANUFACTURING CO.

EXECUTIVE OFFICES:

MUTUAL LIFE BUILDING, 146 BROADWAY, NEW YORK, U. S. A.

OFFICERS:

EDWARDS H. GOFF, President and General Manager; L. M. BATES, Vice-President; H. E. IRVINE, Secretary and Treasurer; JAMES J. WOOD, Electrician.

GENERAL AGENCIES:

American Electric Construction Company, 146 Broadway, New York—New York State.
St. Paul Gas Co., St. Paul, Minn.—State of Minnesota.
Citizens' Gas Light Co., Jacksonville, Fla.—State of Florida.
Sowdon, Elder & Wright, 131 Devonshire St., Boston.—New England States (except Connecticut.)
Pittsburgh Electric Company, Eugene Ingold, General Manager, 213 Wood St., Pittsburgh, Pa.—Western Pennsylvania, Ohio, Kentucky and West Virginia.
J. M. Chipman, 19 North Pennsylvania St., Indianapolis, Ind.—State of Indiana.
Markle Engineering Company, Detroit, Mich.—State of Michigan.

This company has challenged all other systems to a competitive test of merit without response.

For completeness and simplicity of construction, durability and economy in operation, steadiness and quality of light produced, and perfection in automatic regulation, **THE AMERICAN SYSTEM HAS NO EQUAL.**

The Wood Automatic Regulator is entirely original, absolutely perfect in operation, and is the only perfect automatic current regulator ever invented, the pretensions of rival companies to the contrary notwithstanding.

It still invites comparison, and stands ready to meet any known system of Electric Arc Lighting in open fair competitive tests, upon all points of superiority claimed for its apparatus whenever and wherever a sale is guaranteed to the winner.

POINTS OF EXCELLENCE.

The Wood Automatic Regulator is the only known invention that is perfect in its action for regulating the lamps better on long and short circuits.
It saves oil and commutator brushes.
The American system needs less care, and is run at much less expense than any other system.
Its apparatus occupies less space, weighs less, and requires less motive power for carrying any given number of lights than any other.
Its lights are steadier, and it requires less skill than any other to operate its apparatus.
The American system guarantees absolute safety of armatures from burning. This no other company can do, and it is this burning out of armatures in other systems that makes maintenance so expensive.
The American company stands pledged to make good all their claims to any one desiring an Electric Plant of any kind.

ITS ALLIANCE WITH THE GAS COMPANIES. A new element of enormous power is now coming into the company's concerns. The gas interests of the country have been converted to the commercial value of electric lighting as a business enterprise, the particular value of the system owned by this company, and its strong business alliance with the gas property of this company, is worthy of serious consideration of all purchasers of Electric Light Apparatus. Address all communications to

AMERICAN ELECTRIC MANUFACTURING COMPANY,

MUTUAL LIFE BUILDING, 146 BROADWAY, NEW YORK.

GRIMSHAW TRADE MARK B D

NEW YORK INSULATED WIRE CO.

MANUFACTURERS OF

Insulated Wires and Cables for Aerial, Underground and Submarine use

Sole Owners of Grimshaw Wire Patents, Grimshaw Tape. Lead Covered Wire a Specialty.

33 Oliver St., Boston, 64 Broadway, N. Y. 144 Lake St., Chicago, Ill.

W. B. DOWSE, Treas. R. E. GALLAHER, Sec.

NEW ENGLAND GLASS WORKS,

29 MURRAY ST., NEW YORK. 155 FRANKLIN ST., BOSTON.

10 In.—Roughed all over

10 In.—Opal.

9 In.—½ Horizontal Roughed.

12 In.—½ Vertical Roughed.

WE MAKE A SPECIALTY OF

ELECTRIC GLOBES,

OF ALL SHAPES, IN

Clear, Roughed, or Opal Glass.

Our Facilities Enable us to Offer Special Inducements in

QUALITY AND PRICE.

14 In—Clear Flint.

W. L. LIBBEY & SON,

BOSTON, MASS.

SEND FOR PRICES.

A CARD TO THE PUBLIC.

The Edison Electric Light Company having instituted suits on its patents, must decline to substitute the advertising columns of the press for the courts for the purpose of their legal interpretation. Mr. Edison's Carbon filament patent of 1879 covers broadly the modern incandescent lamp. The claim that this patent has ever been in litigation in the United States Patent Office is absolutely false. In Germany and England this fundamental patent has finally prevailed against all infringers, thus establishing the fact that Mr. Edison's great invention has been nowhere anticipated. Ergo, a like result must follow in the United States. The straining and distorting of these facts, together with the violent effort to interweave with them certain minor and IRRELEVANT CASES for the purpose of fraudulently posing before the public as joint heirs with Mr. Edison in the fruits of these patent decisions, only indicate the DIRE EXTREMITY of those who are thus gradually becoming ENVIRONED by due process of law.

THE

Edison Electric Light Co.

16 and 18 BROAD ST., NEW YORK.

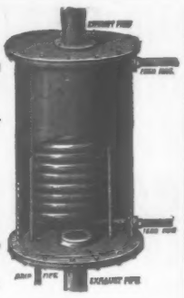
THE
National Feed Water Heater.
A BRASS COIL HEATER,

Supplying feed water to the boiler at 206° to 212° F. A reliable and very effective heater. Over 1,500 in use in the United States.

150 Electric Light Stations Supplied, and Orders being filled every week.

Seventeen sizes manufactured, from 8 to 2,000 H.P.

PRICES LOW AND SATISFACTION UNIVERSAL.



THE NATIONAL PIPE BENDING CO

84 River Street, New Haven, Conn,

Coils and Bends of Brass and Copper Pipe Made to Order.

JARVIS ENGINEERING CO.,
BOSTON, MASSACHUSETTS.

CONTRACTORS FOR

Complete Steam Outfits for Electric Lighting Stations, Steel Boilers with Jarvis Furnaces to burn cheap fuels, Armington & Sims Engines, Etc.

SEND FOR CIRCULARS.

ZELL ENGINEERING COMPANY
Contractors for Steam and Power Plants.
Highest Economy and Efficiency guaranteed.
112 LIBERTY STREET - - NEW YORK.

JOYFUL News for Boys and Girls!! Young and Old!! A NEW INVENTION just patented for Home use!
Fret and Scroll Sawing, Turning, Boring, Drilling, Grinding, Polishing, Screw Cutting. Price $5 to $50. Send 6 cents for 100 pages.
EPHRAIM BROWN, Lowell, Mass.

MICA
For Electrical and Mechanical Uses.
All sizes at low prices.
Send for samples and price list.
A. O. SCHOONMAKER, 158 William St.
NEW YORK.

HEADQUARTERS **MICA** ALL SIZES and QUALITIES.
For ELECTRICAL PURPOSES.
EUGENE MUNSELL & CO.,
218 Water Street, New York.

SHEPARD'S $60. CELEBRATED
Screw-Cutting Foot Lathe.
CAP LATHE, $125.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, &c. Send for catalogue of outfits for amateurs or artisans. Address,
H. L. SHEPARD, Agt.,
134 E. SECOND STREET, CINCINNATI, O.

There are now in use over 18,000
OTTO GAS ENGINES.
Guaranteed to Consume 25 to 75 Per Cent. Less Gas than ANY OTHER GAS ENGINE Per Brake Horse-power.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.
OTTO GAS ENGINE WORKS,
SCHLEICHER, SCHUMM & CO.
N. E. corner 33d & Walnut Sts., Phila.
Branch Office: 130 Washington St., Chicago.

J. E. JEFFORDS & CO.
Manufacturers to the Trade.
POROUS CELLS
Of Every Description, Made to Order.
25 years' experience in this branch of the business.
2716 to 2738 Salmon St., Philadelphia, Pa.

Wellington Belt Holder
The simplest, cheapest and handiest device in existence for shifting Dynamo Belts. Please write for circulars to
W. R. Santley & Co.
WELLINGTON, O.

STANDARD UNDERGROUND CABLE COM'Y.
GEO. WESTINGHOUSE, Jr., President. RICHARD A. WARING, Vice-Pres't and Treas.
JOHN. H. DALZELL, Treasurer. C. H. JACKSON, Secretary.
DIRECTORS—GEO WESTINGHOUSE, JR., RICHARD S. WARING, MARK W. WATSON, JOHN H. DALZELL, ROBERT PITCAIRN, O. T. WARING and C. H. JACKSON.
Manufacturers of
The WARING ANTI-INDUCTION and BUNCHED
Telegraph, Telephone and Electric Light, Underground and Submarine
CABLES,
LEAD COVERED WIRE FOR INSIDE USE, PROOF AGAINST DAMPNESS.
128 Pearl St., N. Y. City, {All Work Guaranteed.} Hamilton Building, 94 5th Ave., Pittsburgh, Pa.

Roberts-Brevoort Electric Co.
(LIMITED,)
Manufacturers of
THE ROBERTS PER-OXIDE BATTERY
AND
THE ROBERTS DRY BATTERY.

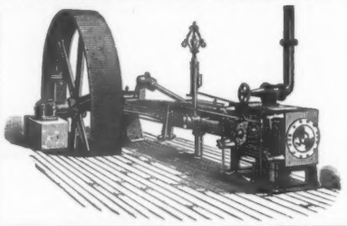
These batteries have each about 1.8 volts. The Per-Oxide Battery is intended for severe open-circuit work. Our dry Battery is **something entirely new.** It is put up in a sealed cell; **no fluid to spill;** can be used in **any position.**
Liberal trade discount. Send for Price List and Circular to the company's office.

Per-Oxide Battery	$1.00
Dry Battery	$1.50

206 Broadway, New York.

FOR SALE BY ALL DEALERS.

HARRIS-CORLISS STEAM ENGINE
BUILT BY
WILLIAM A. HARRIS,
PROVIDENCE, R. I.



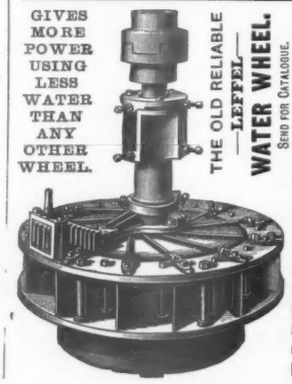
From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of
UNEXCELLED WORKMANSHIP,
and are known the world over as the
MOST ECONOMICAL STEAM ENGINE BUILT.

THE THOMSON-HOUSTON ELECTRIC CO.
PRINCIPAL OFFICE,
178 DEVONSHIRE STREET, BOSTON, MASS.,
Furnishes the only Perfect
Automatic, Self-Regulating System of Electric Arc-Lighting in the World
In all desirable qualities of ELECTRIC ARC-LIGHTS, the Thomson-Houston System has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical, efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.
The Thomson-Houston Electric Company
was awarded the FIRST PRIZE for the *best system* of Arc-Lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.
The Thomson-Houston System
has been awarded *superiority in all the competitive tests* to which it has been subjected.
New Illustrated Pamphlet will be sent on application.

VICTOR
Turbine Water Wheel.
The attention of **Electric Companies** is called to this **celebrated water wheel** as particularly adapted to their use, on account of its **remarkably steady motion, high speed** and **great efficiency,** and **large capacity** for its **diameter,** being **double** the **power** of most **wheels** of **same diameter.** It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect, **guaranteed.**
SEND FOR CATALOGUE AND PARTICULARS.
STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.
(Please Mention this Paper.)

HARD RUBBER.
For all Electrical Purposes. In Sheets, Rods, Tubes, and special designs as ordered when practicable. Rubber Hook Insulators, Window Tubes with Heads, Key Knobs, Switch Handles, Plug Handles, Battery Cells, Battery Syringes, Electric Lamp Switch Handles, &c., &c. Manufactured by
THE BUTLER HARD RUBBER COMPANY,
88 MERCER STREET. NEW YORK.

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.



THE OLD RELIABLE —LEFFEL— **WATER WHEEL.**
SEND FOR CATALOGUE.
JAMES LEFFEL & CO.
SPRINGFIELD, O., OR 110 LIBERTY ST., N.Y.

Lowest Prices
FOR
BELLS,
HAZAZER & STANLEY,
32 Frankfort Street,
NEW YORK.

PAINE & LADD,
HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.
Attorneys in Patent Causes And Solicitors of Patents.
WASHINGTON, D. C.

Shultz Belting Company,

MANUFACTURERS OF

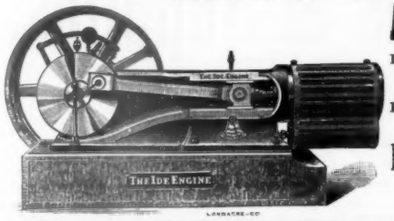
SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER.

Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned, but rawhide fulled and softened by our patented process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

THE IDE ENGINE,

THE MOST SIMPLE, DURABLE AND ECONOMICAL



Automatic Cut-Off Engine

In the World. References furnished from the most successful Electric Light Plants in the United States. Medal and Highest Award from Franklin Institute of Philadelphia, Pa.

MANUFACTURED BY

Foundry and Machine Dept.

Harrisburgh Car Mfg. Co.

HARRISBURGH, PA.

ELECTRICAL PATENTS.

GEORGE H. BENJAMIN,

35 Wall St., New York.

Consulting Electrical Engineer,

Expert in Patent Causes,

Solicitor of U. S. and Foreign

PATENTS for ELECTRICAL INVENTIONS.

EDISON LAMPS.

½ to 6 Candle Power—Special, 135 ohm Resistance Lamps, Battery Lamps of 16 Candle Power, 25 to 40 Volts.

$1.50 EACH.

50 per cent. discount, when ordering one dozen. Special rates on large orders.

STOUT MEADOWCROFT COMPY.

82 and 84 FULTON STREET, NEW YORK CITY.

P. O. Box. 2411.

H. M. RAYNOR,

No. 25 BOND ST., NEW YORK.

Established 1850.

PLATINUM IN All Form FOR ALL PURPOSES

WHOLESALE AND RETAIL

PRECAUTIONS to be ADOPTED

ON INTRODUCING

THE ELECTRIC LIGHT.

With notes on the Prevention of Fire Risks, and a glossary of common terms used in Electrical Engineering. By Killingworth Hedges.

Price $1.00.

E. & F. N. SPON, 35 Murray St., New York.

DIRECT READING Am-meters and Volt-meters.

(A. K. EATON'S PATENT.)

VOLT-AM METER.

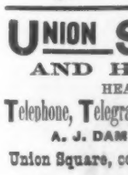
ALSO

ELECTRICAL INSTRUMENTS of all kinds

Manufactured and for sale by

A. K. EATON, 63 and 65 Henry Street, Brooklyn, New York.

STANDARD



Electrical Test Instruments.

Galvanometers, Resistance Coils, Condensers, Keys Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.

Electric Mfg. Co., Troy, N. Y.

OFFICE. 311 RIVER STREET.

UNION SQUARE HOTEL,

AND HOTEL DAM,

HEADQUARTERS:

Telephone, Telegraph and Electric Light People.

A. J. DAM & SON, Proprietors,

Union Square, cor. 15th Street, New York.

THE

AMERICAN ELECTRICAL DIRECTORY,

Handsomely Bound and Finished in Cloth, Containing 500 pages devoted to the

INTERESTS OF ELECTRIC LIGHTING.

A Complete List of All and a Report of

Each Electric Light Co. in North America

A Handy Book for Reference.

—PRICE, $2.00—

Published by the

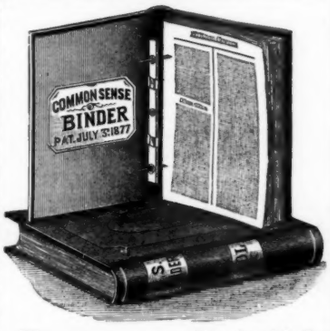
STAR IRON TOWER CO.,

Fort Wayne, Ind., U. S. A.

BINDERS

FOR THE

ELECTRICAL REVIEW.



We are now prepared to furnish for the convenience of subscribers to the

REVIEW,

Or for any other Electrical or Scientific journal published in this country,

one of the latest improved self-binders. The binders are of the exact size of the paper, and each issue, as received, can be filed in it without trouble. When the volume is complete at the end of the year, it can be permanently fastened in a moment, making in appearance a volume almost as durable as one specially bound. The binder will be sent, postage prepaid, to any part of the United States, on receipt of $1.00. Address,

ELECTRICAL REVIEW,

P. O. Box 3329. 23 Park Row, New York.

PROTECTION FOR WATCHES.

The Anti-Magnetic Shield is an absolute protection from all Electric and Magnetic Influence. Can be applied to any watch. Full Experimental Exhibition and Examination, also full assortment of the watches complete at

Anti-Magnetic Shield & Watch Case Co

18 JOHN ST., NEW YORK.

F. S. GILES, Agent, or

GILES, BRO. & CO. Chicago, Ill.

AMERICAN AND FOREIGN BOOKS

On Electricity and its Applications.

Angell. Elements of Magnetism and Electricity. Cloth, 238 pages, 151 illustrations ..... $ 60
Avery. Modern Electricity and Magnetism. Cloth 75
Benjamin. Age of Electricity 2 00
Brennan. A Popular Exposition of Electricity. 191 pages 75
Cavendish. Electrical Researches. Cloth 5 00
Cook. Magnetism and Electricity. Cloth, 46 illustrations 40
Cumming. Theory of Electricity. Cloth, 100 diagrams 2 25
Deschanel. Electricity and Magnetism. Cloth 1 50
Faraday. Experimental Researches in Electricity. 3 vols, cloth 20 00
Fiske. Electricity in Theory and Practice. Cloth, 270 pages, 180 illustrations 2 50
Ferguson. Electricity. Cloth 1 50
Gordon. School Electricity. Cloth, 262 pages, 139 illustrations 2 00
Gordon. A Physical Treatise on Electricity and Magnetism. 2 vols, cloth 10 00
Harris. Rudimentary Electricity. Flexible, 69 illustrations 60
Harris. Rudimentary Magnetism. Cloth, 165 illustrations 1 40
Harris. Galvanism, Animal and Voltaic Electricity 60
Jenkin. Electricity. Cloth, 122 pages 40
Jenkin. Electricity and Magnetism. Cloth, 177 illustrations 1 50
Lardner. Hand-Book of Electricity, Magnetism and Acoustics. 400 illustrations, cloth 2 00
Levander. Solutions of Questions in Magnetism and Electricity. Cloth 1 00
Mascart and Joubert. A Treatise on Electricity and Magnetism. Vol, 1, cloth, 654 pages, 127 ill. 7 50
Maxwell. A Treatise on Electricity and Magnetism. 2 Vols., 20 plates, and 105 illustrations 8 60
Maxwell. An Elementary Treatise on Electricity. 6 plates, 54 illustrations 2 00
Miller. Magnetism and Electricity. 212 pages, illustrated 2 50
Munro. Electricity and its Uses. Cloth 1 40
Murdock. Notes on Electricity and Magnetism. Cloth, 38 illustrations 60
Noad. The Students Text-Book of Electricity. Cloth, illustrated 4 00
Overend. Elementary Experiments in Magnetism and Electricity. Cloth 40
Pynchon. Introduction to Chemical Physics. 550 pages, 269 illustrations 3 00
Sprague. Electricity: Its Theory, Sources and Application. Cloth, 650 pages 6 00
Thompson. Elementary Lessons in Electricity and Magnetism. Cloth, 168 illustrations 1 25
Tyndall. Light and Electricity. Cloth 1 25
Tyndall. Lessons in Electricity at the Royal Institute. 1875-6. Cloth 1 00
Wason & Burbury. The Mathematical Theory of Electricity and Magnetism. Cloth, 368 pages, ... 2 75
Wonders of Acoustics: or, The Phenomena of Sound. Cloth. 288 pages 1 00
Woodbury's Protection and Construction of Mill Floors. Cloth 2 50

BOOKS ON TELEGRAPHY AND TELEPHONY.

Abernethy. Commercial and Railway Telegraphy. Illustrated, Cloth 2 00
Bond. Hand-Book of the Telegraph. Cloth 1 20
Beechey. Electro-Telegraphy. Cloth, 36 illustrations 40
Clarke & Sabine. Electrical Tables and Formulæ. Cloth 5 00
Culley. Hand-Book of Practical Telegraphy. Cloth, 442 pages 6 00
Davis & Rae Hand-Book of Electrical Diagrams and Connections 2 00
Fahie History of Telegraphy to 1837. Cloth, 529 pages 3 00
Douglas. A Manual of Telegraph Construction 83 diagrams, cloth 6 00
Hoskiaer. Laying and Repairing Electric Telegraph Cables. Cloth 1 50
Hoskiaer. A Guide for the Electric Testing of Telegraph Cables. Cloth 1 50
Lockwood. Electricity, Magnetism and Electric Telegraphy. Cloth, 376 pages 2 50
Loring. A Hand-Book of the Electro-Magnetic Telegraph. Boards, 50c, cloth, 75c, morocco, 1 00.
Maver & Davis. The Quadruplex. Cloth, 126 pages 1 50
Pope. The Modern Practice of the Electric Telegraph. Cloth, 70 illustrations 1 50
Plum. The Military Telegraph During Our Civil War. Two vols., portraits and illustrations 5 00
Preece & Siveright. Telegraphy. Cloth 1 50
Prescott. Electricity and the Electric Telegraph. Cloth, 670 illustrations, 2 vols 5 00
Sabine. History and progress of the Electric Telegraph. Cloth, 184 illustrations 1 25
Smith. Manual of Telegraphy. 31 illustrations, paper 30
Schwendler. Instructions for Testing Telegraph Lines. 2 vols., cloth, illustrated 8 00
Terry & Finn. Illustrations and Descriptions of Telegraphic Apparatus. Cloth, 92 pages, 30 plates 1 50
Williams. Manual of Telegraphy. Cloth, 327 pages, 90 illustrations 4 50
Dolbear. The Telephone. Cloth, illustrated 50
Du Moncel. The Telephone, the Microphone, and the Phonograph. 70 illustrations, cloth 1 25
Lockwood. Practical Information for Telephonists. Cloth 1 00
Prescott. Bell's Electric Speaking Telephone. 536 pages, 292 illustrations 4 00
Thompson. Philip Reis, Inventor of the Telephone. Cloth, 5 plates and 48 engravings 3 00

ELECTRIC LIGHTING AND TRANSMISSION OF POWER.

Alglave & Boulard. The Electric Light: Its History, Production and Application. 458 pages. 5 00
Cunyngame. A Treatise on the Law of Electric Lighting. Cloth 5 00
Day Electric Light Arithmetic. Cloth 40
Du Moncel. Electric Lighting. 66 illustrations. cloth 1 25
Du Moncel. Incandescent Electric Lights. Illustrated, boards 50
Dredge. Electric Illumination. 2 vols., cloth. Vol. 1 (scarce), $15 00. Vol. 2 ..... 7 50
Electric Lighting Act, 1882, also the Rules of Board of Trade, October, 1882 ..... 2 00
Gordon. A Practical Treatise on Electric Lighting. Cloth 4 50
Hedges. Useful Information on Electric Lighting. Cloth, illustrated 1 75
Hammond. The Electric Light in our Homes. Cloth 1 25
Holmes. Practical Electric Lighting. Cloth 1 00
Higgs. Magneto and Dynamo Electric Machines. 301 pages 2 00
Hopkinson. Dynamic Electricity. Boards 50
Prescott. Dynamo-Electricity. Cloth 5 00
Stephen. Wrinkles in Electric Lighting. Cloth, 45 pages, 23 illustrations 1 00
Swinton. Electric Lighting. Its Principles and Practice. Cloth 120 pages 1 50
Sawyer. Electric Lighting by Incandescence. 96 illustrations, cloth 2 50
Schellen. Magneto-Electric and Dynamo Electric Machines. Cloth 5 00
Schoolbred. Electric Lighting and its Practical Applications 2 00
Thompson. Dynamo-Electric Machines. Illustrated, boards 50
Thompson. Dynamo Electric Machinery. 57 illustrations, boards 50
Thompson. Dynamo-Electric Machinery. Cloth, 527 pages. 324 illustrations 5 00
Thurston. Stationary Steam Engines, especially as adapted to Electric Lighting Purposes 2 00
Urquhart. Electric Light: its Production and Use. Cloth, 94 illustrations 3 00
Du Moncel. Electricity as a Motive Power. Cloth 3 00
Kapp. Electric Transmission of Energy and its Transformation 3 00
Luce. Electric Railways and the Electric Transmission of Power. Illustrated- Paper, 50c, cloth 1 00
Urquhart. Electro Motors. Illustrated 3 00

TESTING AND MEASUREMENTS.

Gray. Absolute Measurements in Electricity and Magnetism. Illustrated, 207 pages, cloth 90
Haskins. The Galvanometer and its Uses. Morocco, 8 illustrations 1 50
Kempe. A Hand-Book of Electrical Testing. Cloth, 404 pages 5 00
Lockwood. Electrical Measurement and the Galvanometer. Cloth 1 50

ELECTRO-METALLURGY, ELECTROTYPING, ETC., ETC.

Fontaine. Electrolysis. Cloth. 264 pages 3 50
Gore. The Art of Electro-Metallurgy. Cloth, illustrated 2 25
Napier. A Manual of Electro-Metallurgy. Cloth 3 00
Urquhart. Electrotyping. A Practical Manual 2 00
Urquhart. Electro-Plating. Cloth 2 00
Wahl. Galvanoplastic Manipulations. Cloth 7 50
Watt. Electro-Metallurgy, Practically Treated. Cloth 1 00
Watt. Electro-Deposition. Cloth, 568 pages, 144 illustrations 5 00
Wilson. Stereotyping and Electrotyping. Cloth, 195 pages 2 00
Anderson. Lightning Conductors. Cloth 6 50
Blakesley. Alternating Currents of Electricity. Cloth 60
Bottome. The Dynamo. How Made and How Used. A book for amateurs. Cloth 1 00
De Fonvielle. Thunder and Lightning. Cloth, 285 pages 1 00
Du Moncel. Electro-Magnets. Boards, 50c., English edition 75
Dyer Induction Coils; How Made and How Used. Boards 50
Gladstone & Tribe. The Chemistry of the Secondary Batteries of Plante and Faure 1 00
Gordon. Four Lectures on Static Electric Induction. Cloth 80
Gore. Electro-Chemistry, Inorganic. Cloth, 138 pages 50
Heap. Electrical Appliances of the Present Day. Cloth 2 00
Hospitalier. Domestic Electricity. Cloth, 229 pages, 155 illustrations 3 00
Hospitalier. The Modern Applications of Electricity. Cloth 8 00
Kohlrausch. Physical Measurements, with Appendices on Absolute Electrical Measurements 6 00
Lock. Workshop Receipts. Devoted mainly to Electrical and Metallurgical subjects. Cloth 2 00
Munro & Jamieson. Electricians' Pocket-Book of Electrical Rules and Tables 2 50
Niaudet. Elementary Treatise on Electric Batteries. Cloth, 55 illustrations 2 50
Parnell. Action of Lightning and Means of Defending Life and Property from its Effects 3 00
Radau. Wonders of Acoustics; or, The Phenomena of Sound. Cloth, 288 pages, 116 illustrations 1 00
Reports of the Committee on Electrical Standards. Cloth 3 75
Spang Treatise on Lightning Protection. Cloth. Illustrated 75
Swinburne. Practical Electrical Units Popularly Explained. Cloth 60
Welch. Table of Relative Weights of Copper Conductors 10
Wigan. The Electricians Pocketbook. English edition of Hospitalier's "Formularie Practique pour l'Electrician." Cloth. 318 pages, 48 illustrations 2 00
Woodward. Arithmetical Physics. Boards 40

☞Copies of any of the above books will be promptly mailed, POSTAGE PREPAID to any address in the world on receipt of price. Remit by Express or Post Office Money Order, Postal Note, Draft or Registered Letter. Address.

ELECTRICAL REVIEW PUB. CO.

P. O. Box, 3329, New York.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph & Telephone Apparatus & Supplies.

The Best of Everything at Bottom Prices.

AUTOMATIC CUT-OFF ENGINE

Embodying a New System of Regulation.

THE GOVERNOR WEIGHS THE LOAD.

Send for Circular F

BALL ENGINE CO., ERIE, PA.

General Sales Agents
S. L. HOLT & CO.
67 Sudbury St. Boston, Mass.
KINGSLAND BROS. & CO.,
28 S. Canal St., Chicago, Ill.
622 N. 2d St., St. Louis, Mo.
TATUM & BOWEN,
Portland, Oregon. San Francisco, Cal.
BROOK, HORNER & CO., Baltimore, Md.

WE CHALLENGE THE WORLD on good regulation. Only Engine which ABSOLUTELY HOLDS to constant speed under all changes of load. An indispensable Feature for *ELECTRICAL LIGHTING*.

V. L. RICE, 66 Kasota Block, Minneapolis, Minn.

THE UNITED STATES ILLUMINATING CO.

59 AND 61 LIBERTY STREET, NEW YORK.

SOLE GRANTEES OF THE PATENTS OF WESTON, MAXIM, FARMER AND OTHERS FOR THE CITY OF NEW YORK AND VICINITY.

Five years' practical experience in the installation of these well-known systems of Arc and Incandescent Electric Lighting, enables the Company to give the most perfect, reliable and economical Electric Lighting known.

Among the most prominent installations which this Company has effected in the city and vicinity, are the following:

New York Post Office,
Washington Building,
Mortimer Building,
Union Ferry Co.,
Pennsylvania R. R. Ferry,
Mutual Life Insurance Co.,
Coleman House,
Hotel Dam,
Hotel Normandie.
St. Denis Hotel,
Bechtel's Brewery, Staten Island,
Brooklyn Eagle,
Opperman & Muller, Turtle Bay Brewery,
Equitable Building,
New York Ferry Co.,
Tribune Building,
U. S. Custom House.
Press Club,
Delmonico's,
Hotel Brunswick,
Lotus Club,
Union Club,
Union Square Hotel,
Brooklyn Bridge, and others
Theodore Stewart,
Hotel Royal.

Estimates made by Experts at short notice, on application at the office of the Company.

SCHAEFER ELECTRIC MFG. CO.

INCANDESCENT LAMPS, From 10 to 100 Candle Power. DYNAMO MACHINES of Improved Construction.

Proposals and Estimates furnished for Complete Installations of Incandescent plants upon application to

P. O. Box, 3068, Boston, Mass.

FACTORY AT CAMBRIDGEPORT, MASS.

ARC AND GLOW LAMPS.
A PRACTICAL HAND BOOK
—ON—
Electric Lighting,
By JULIUS MAIER, Ph. D.
376 Pages, 82 illustrations.
PRICE, $3.00.
Will be sent to any address, postage prepaid on receipt of price. Address,
ELECTRICAL REVIEW,
23 Park Row, New York.

THE
Age of Electricity,
By PARK BENJAMIN, Ph. D.
381 Pages, 143 Illustrations. Price, $2.
A COMPLETE HISTORY OF ELECTRICITY.
Will be sent to any address, postage prepaid, on receipt of price. Address,
ELECTRICAL REVIEW,
23 Park Row, New York.

H. G. CHENEY, President. P. H. WOODWARD, Secretary and Treasurer. ROBERT CHENEY, Vice-President.
N. T. PULSIFER, General Manager. R. H. MATHER, Con. Electrician.

THE MATHER ELECTRIC CO.

HARTFORD, CONN.,

Sole Manufacturers under all the Patents of Richard H. Mather for

Electric Lighting and Transmission of Power.

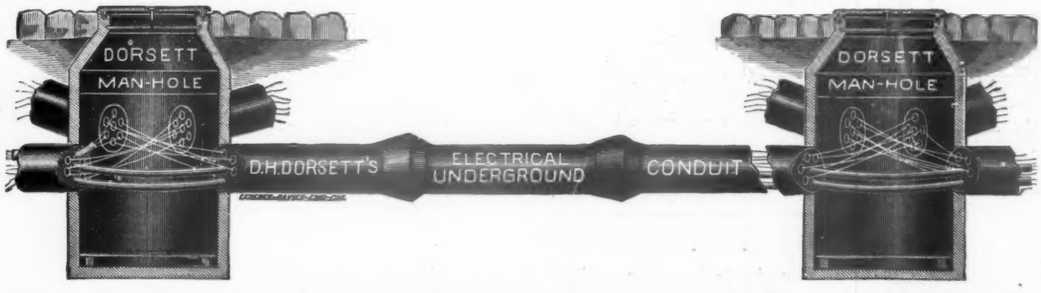
Also Sole Manufacturers under all the Patents of Charles G. Perkins for

Incandescent Lamps and Appliances for Incandescent Lighting.

EXECUTIVE OFFICE, HARTFORD, CONN.

New York Office, 145 Broadway.
Chicago Office, 117 and 119 Lake St.
Cincinnati Office, Carlisle Building.
Atlanta Office, 16 North Broad Street.

DORSETT'S UNDERGROUND CONDUIT SYSTEM.



Electrical Insulator, Water, Gas and Sewage Proof! Absorbs no Moisture! Frost Cannot Affect It!

CRUSHING STRAIN, 5,500 LBS. PER SQUARE INCH—GOVERNMENT TEST.

A Complete, Comprehensive System of Conduits for Electric Light, Telegraph, Telephone and Private Wires and Cables for Rental Purposes.

The 2¼-inch ducts in this Conduit are leased to different companies, which may then occupy them with such wires and cables as they may adopt. New wires may be introduced or old ones replaced through these ducts between the man-holes as shown in the cut.

An experience of six years for Underground Drainage has shown the superiority of this material as a resistant of moisture, and its consequent immunity from damage by frost. It has been in use for electrical purposes the past winter in the solidly frozen streets of Chicago without injury; is the system used by that city, giving perfect, unbounded satisfaction, and is now being introduced into the cities of St. Louis, Cincinnati and Detroit. The whole body of the Conduit is a thoroughly reliable insulator, unaffected alike by acids and alkalies. The cheapest and most perfect Conduit in the market to-day.

☞ CORRESPONDENCE SOLICITED. ☜

D. H. DORSETT, Proprietor, No. 61 La Salle Street, Chicago, Ill.

GUTTA PERCHA IS THE STANDARD INSULATION.

Does not deteriorate, and for underwater or underground is the most Reliable and Durable.

Aerial or Underground. Any number of Conducting Wires.

Marks' Compound and Balata Insulated Wires, Cordage and Cables, for Office, Aerial, Underground and Battery Uses.

Balata Cord, for Incandescent Light.

RIVER CABLES. Gutta Percha Insulation. Any number of Conductors.

Burglar Alarm, Annunciator, Electric Light and Gas Lighting Wires and Cables. Silk, Cotton and Fibre Covered Magnet Wires, Flexible Cables and Cordage. G.P. Sheet or Chatterton's Compound for Cable Splices, and Pure G.P. Goods of every variety

Acid Vessels, Pipes, Vats, Etc.

Marks' Compound Wire, for Battery Coppers.

H. S. HAYDEN, Prest. and Treas. JOHN C. FRANCIS, Secy

—THE—

Waterbury Electric Co.,

MANUFACTURERS OF

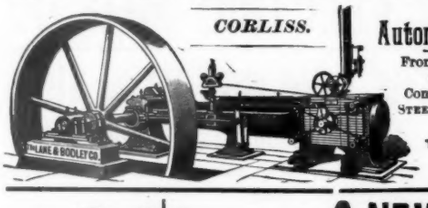
ELECTRICAL APPARATUS,

Magneto Bells, Electric Light and Telephone Supplies.

Send for our Prices Before Purchasing Elsewhere. Estimates Furnished on Special Instruments and Machinery.

WATERBURY, CONN.

The Lane & Bodley Co.



CORLISS.

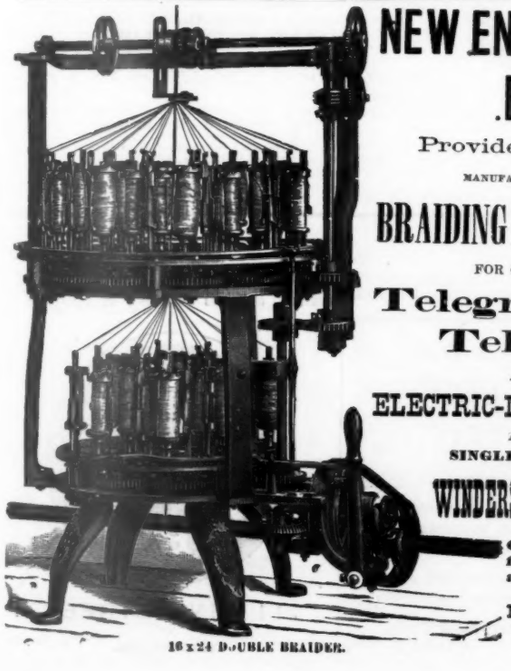
MANUFACTURERS OF

Automatic Cut Off Engines,

From heavy patterns, and unequaled for ELECTRIC LIGHTING, Combining Economy and Reliability.

STEEL BOILERS, HEATERS, SHAFTING, PULLEYS AND GEARING.

THE LANE & BODLEY CO,
265 to 273 Water St.,
Cincinnati, O.



16 x 24 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

Telegraph, Telephone

AND

ELECTRIC-LIGHT WIRE.

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY.

SOUTHERN ELECTRIC COMPANY.

ELECTRIC LIGHT SUPPLIES.

Insulators, Cross-arms, Locust and Oak Pins, Chestnut and Cedar Wire Poles, Turned Lamp Posts, Galvanized Iron Pole Steps, Ornamental Wrought Iron Brackets, Insulated Coppe Line Wire, &c.

REPAIRS TO MACHINES AND LAMPS OF ANY SYSTEM MADE PROMPTLY. DUPLICATE PARTS OF APPARATUS FURNISHED ON RECEIPT OF SAMPLE.

We manufacture and keep in stock **PHOSPHOR-BRONZE BRUSHES**, which are in every way superior to the copper brush. They spark less, last longer and do not cut the Commutator. Commutator Rings last twice as long when our Brushes are used

Fittings for Incandescence Lamps made to order, including Sockets, Holders, Switches, Cut-outs, Shade holders and all other Appliances necessary to the business.

WAREROOMS,

Hoen Building, North & Lexington Sts.

WORKS,

CONSTITUTION & MONUMENT STS.,

BALTIMORE, MD.

BOOKS

ON ELECTRICAL SUBJECTS will be mailed to any address, postage prepaid, on receipt of price. Address, ELECTRICAL REVIEW PUB. COMPANY, 23 Park Row, New York. P. O. Box, 3,329.

Arc Light, and Gas Companies

ATTENTION!

Owing to Recent Improvements we now make a Specialty of

CENTRAL STATION WORK

AND OFFER THE

MOST COMPLETE AND ECONOMICAL

SYSTEM OF

Incandescent Lighting

YET DEVISED FOR THIS PURPOSE.

The COST of Installation is GREATLY Reduced and LONG DISTANCE Lighting Successfully Accomplished, from a COMMERCIAL STANDPOINT.

FOR FULL INFORMATION ADDRESS

The United States Electric Lighting Co.

59 and 61 LIBERTY ST., NEW YORK.

216 LA SALLE ST., CHICAGO, ILL.

CHAS. A. CHEEVER, President. WILLARD L. CANDEE, Treasurer

THE OKONITE CO.

TRADE MARK.

INSULATED WIRES AND CABLES.

CHICAGO BRANCH, 1022 Opera House Building. | 13 Park Row, New York.

Thermostats and Thermostatic Fire-Alarm Apparatus.

Thermostat Two-thirds Actual Size.

OUR PATENT CLOSED-CIRCUIT SYSTEM IS ABSOLUTELY RELIABLE AND ECONOMICAL, AND DOES NOT GIVE A FALSE ALARM WHEN THE CIRCUIT IS BROKEN ACCIDENTALLY.

Our patent hydro-carbon thermostat is ornamental, adjustable and never ailing, closing or opening the circuit with great force, and does not destroy itself by use. A sample thermostat mailed on receipt of one dollar.

Territorial rights and licences can now be negotiated.

SEND FOR CIRCULAR TO

The Martin-Wilson Automatic Fire Alarm Co., 53 State St., Boston, Mass.

3-Conductor Aerial Telephone Cable.

DAY'S Kerite Insulated WIRES AND CABLES

For Telephone, Telegraph and Electric Light Use and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short-lived when placed either in the air or under ground, and the supposed new insulating materials now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of TELEPHONE MANAGERS is especially asked to our ANTI-INDUCTION TELEPHONE CABLES, they being the most practical and durable in the market.

TELEGRAPH, TELEPHONE and ELECTRIC-LIGHT WIRES for either SUBMARINE or UNDERGROUND WORK a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.

AUSTIN G. DAY, Sole Manufacturer,

CLARK B. HOTCHKISS, Gen'l Agent,

16 DEY STREET, NEW YORK.

The Brush-Swan Electric Light Co.

OF NEW ENGLAND.

W. L. STRONG, President. GAYLORD McFALL, Secretary.
A. D. JUILLIARD, Vice-President. R. W. ABORN, Treasurer.
JOHN B. POWELL, General Manager.

OFFICE, No. 36 UNION SQUARE, (EAST).

NO OTHER SYSTEM IS AS ECONOMICAL IN INSTALLATION AND MAINTENANCE

NO OTHER ELECTRIC LIGHT APPARATUS IS AS DURABLE.

THE FIRST MACHINES MADE ARE STILL IN DAILY OPERATION.

THE SYSTEM COMPRISES: { Arc Lights of various Sizes. Arc and Incandescent Lights from one Dynamo and Circuit. Incandescent Lights of various Sizes from Special Dynamo for Central Station Lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates Furnished by Experts

G. W. STOCKLY, President. J. J. TRACY, Vice-Prest. W. F. SWIFT, Secretary.
J. POTTER, Treasurer. N. S. POSSONS, Supt. W. J. POSSONS, Asst. Supt.

THE BRUSH ELECTRIC CO.

The Sole Manufacturers, under all the patents of Charles F. Brush, for Electric Lighting, Storage Batteries, Carbons, Electro-Plating Machines, Electric Motors, etc.

WE FURNISH THE ONLY COMPLETE and PERFECT SYSTEM OF ELECTRIC LIGHTING.

Machines for Arc Lighting, giving lights of 1,200, 2,000, 3,000, 4,000, and up to 100,00 candle power. Our No. 8 machine gives 65 lights of 2,000 c. p. with about 45 H. P.

Over twenty different styles of arc lamps, for indoor and outdoor use, and for tower lighting.

MACHINES FOR INCANDESCENCE LIGHTING,

adapted for use with Swan Incandescence lamps. These machines are automatic and do not require the use of any switches or resistances outside of the machine to govern the current. Will run any number of lamps from one up to the full capacity of the machine, without change of speed and without the use or any apparatus outside of the machine.

Our prices are lower than other makers.

Storage Batteries, for Incandescence Lighting and for **Electric Motors.** Our storage batteries are the only practical ones offered in the market.

CARBONS FOR ARC LAMPS.

Our carbons are the purest and best made. We have the largest and most fully equipped carbon factory in the world, and our prices are very low.

ELECTRIC MOTORS.

We have commenced the manufacture of the Brush Electric Motors and shall soon be prepared to fill orders for all sizes from one up to forty horse-power. In many locations these are the most economical producers of power and will be largely used by Lighting Companies and others where small powers are required.

THE BRUSH ELECTRIC CO., *Cleveland, O., U.S.A.*

ANSONIA BRASS & COPPER CO.,

Manufacturers of

Pure Electric Copper Wire,

BARE AND COVERED, OF EVERY DESCRIPTION.

"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE.

Warerooms: 19 & 21 Cliff St., New York. Factories: Ansonia, Conn.

Incandescent Lighting on Arc-Light Circuits.

The Brown Automatic Converter

Will supply and take care of ten to twelve 16 C. P. Incandescent Lamps, at any point on an arc-light circuit from an initial current equal to 2,000 C. P. arc lamp.

Can be used with any make of arc-light dynamo.

Any number of the lamps can be turned on or off without affecting the rest.

Invaluable to arc lighting companies as a means by which they can secure customers, from one up, for incandescent lighting anywhere on their circuit, without involving the large expense for incandescent lighting plants, or the necessity of getting a large number of subscribers to commence with. Address,

THE BROWN ELECTRIC CO.,

400 WOOD ST., PITTSBURGH. PA.

FOREST CITY CARBON MFG. CO.

MANUFACTURERS OF

AUSTRIAN-AMERICAN CORED CARBONS,

—ALSO—

Solid Carbons for Electric Arc Lighting.

HOLMES, BOOTH & HAYDENS,

SOLE AGENTS,

No. 25 PARK PLACE, NEW YORK.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

THE ARMINGTON & SIMS

Automatic Cut-Off Engine,

FOR ALL PURPOSES WHERE POWER IS REQUIRED.

CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.

OVER 2,000 ENGINES IN USE.

SELLING AGENTS.

JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
J. F. RANDALL, Warren, Ohio.
JOHN R. MARKLE, Detroit, Mich.
H. B. SMITH MACHINE CO., 925 Market St., Phil., Pa.
F. H. HAYWARD, 81 Lake St., Chicago, Ill.
T. W. ANDERSON, New Orleans, La.
E. P. HAMPSON & CO., 36 Cortlandt St., New York.
TANNER & DELANEY ENGINE CO., Richmond, Va.
MORTON REED & CO., Baltimore, Md.
A. J. MILLER, Danville, Va.
W. R. BURGESS, Greensboro, N. C.
W. S. JOHNS, Pensacola, Fla.
S. S. PUGH M, Macon, Ga.
J. A. HAUSER, Montgomery, Ala.

William Marshall,

Manufacturer of ELECTRICAL CONDENSERS.
STANDARDS A SPECIALTY.
Rooms 2 and 4 University Building.
Corner Waverley and University Places, New York.

ELECTRIC LEATHER BELTING

MOST RELIABLE FOR DYNAMOS AND SWIFT-RUNNING MACHINERY.

Warranted to run steady and smooth, and without stretching
Write for particulars and prices to

CHARLES. A. SCHIEREN & CO

Manufacturers and Tanners of Oak Leather Belting and Lace Leather.

47 Ferry Street, New York.

18 ARCH ST., PHILADELPHIA. 86 FEDERAL ST., BOSTON

THE

Parker-Russell Mining & Mfg. Co.

711 PINE STREET,

ST. LOUIS, MO.